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THE ASSOCIATION was organized in Boston, Mass., on June 21, 1882, with the object of providing its members with means of social intercourse and for the exchange of knowledge pertaining to the construction and management of water works. From an original membership of only TWENTY-SEVEN, its growth has prospered until now it includes the names of over **1,000** men. Its membership is divided into two principal classes, viz.: MEMBERS and ASSOCIATES. Members are divided into two classes, viz.: RESIDENT and NON-RESIDENT, — the former comprising those residing within the limits of New England, while the latter class includes those residing elsewhere. The INITIATION fee for the former class is FIVE dollars; for the latter, THREE dollars. The annual dues for both classes of Active membership are THREE dollars. Associate membership is open to firms or agents of firms engaged in dealing in water-works supplies. The initiation fee for Associate membership is TEN dollars, and the annual dues FIFTEEN dollars. This Association has six regular meetings each year, all of which, except the annual convention in September, are held in Boston.

New England Water Works Association

ANNOUNCEMENT

It is planned to start a column of Water Works Notes and Personals as a new feature of the Journal for 1917. In order to have this column of interest, it is necessary to have the support of the members.

It is hoped that superintendents and engineers will send in notes of work they are doing, and descriptions of difficulties encountered, that are of considerable interest but possibly not extensive enough for a formal paper.

Associates can tell us of improvements in their supplies and of work in which they are interested.

Enough members ought to be able to send to the editor a page or a paragraph of these notes before February 15, 1917, to make this column of interest to all.

Table of Contents.

PAGE

An Emergency Gang in a Water Service. By George H. Finneran 413

Meter Records for Small Water Works. By A. W. F. Brown 427

A Suggestion that the Association Appoint a Committee to Prepare Standard Specifications for Water Meters. By Robert J. Thomas 430

Leakage from Pipe Joints. By F. A. Barbour 439

Committee on Meter-Rates. Report on Waste; to which is added Suggestions for Service Charges for Large Meters 453

Proceedings:

- September Convention 479
  - Address by W. G. Chapman, Mayor of Portland 486
  - Address by W. B. Moore, Esq. 488
  - Address by W. L. Blake, Esq. 489
  - Report of the Committee on the Dexter Brackett Memorial 492
  - Committee on Nominations appointed 495
  - Committee on Consumption of Water appointed ... 497
  - Address by Admiral R. E. Peary, U. S. N. 497
  - Address by Mr. Cummings 506
  - Committee on Uniform Accounting appointed 513
  - Address by Judge Cleaves 516
  - Report of Committee on Exhibits 528
- November Meeting 531
- Executive Committee:
  - September 13 535
  - November 8 537

New England Water Works Association.
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This Association, as a body, is not responsible for the statements or opinions of any of its members.

AN EMERGENCY GANG IN A WATER SERVICE.

BY GEORGE H. FINNERAN, GENERAL FOREMAN, WATER SERVICE, BOSTON, MASS.

[*Read September 14, 1916.*]

Failure of a pipe carrying water under pressure always spells trouble to the water-works man, the extent of which varies according to the size, location, and importance of the pipe.

Until the advent of subways, underground wires, improved sewerage, pneumatic tubes, buildings two and three basements deep, and rapidly moving and heavily loaded vehicles, failures occurred occasionally, but usually were due to defective material, water ram, or frost. In the city of to-day, however, with its activity under and over ground, leaks and breaks are frequent, the causes varied, and the consequences more or less serious. The prime factor in the cause of almost all failures is disturbance. Disturbance of a pipe or the surrounding earth is certain to result sooner or later in a leak or break. If the disturbance is quick or violent and of the nature of a shock, the effect is immediate. If it is slow, insidious, and progressive, the effect will develop in time; but, in either case, the time, the place, or the extent of the break cannot be foretold, hence preparation is necessary to meet adequately the situation when it arises.

The first steps towards properly caring for a leak or break is promptly to stop the flow of water. This requires the presence of men with wrenches or valve keys at the location of the trouble, and to get these men on the ground with as little delay as possible it is desirable to transport them in a rapidly moving vehicle. The

automobile meets that requirement better than anything we know of at present. It is therefore obvious that to be prepared to control a break in a water pipe, whether it is large or small, a special force, consisting of men, tools, and an automobile, is a necessary complement to the distribution system of every large water works. Such a force is commonly called an " emergency gang."

The men in an emergency gang should be selected carefully for certain qualifications that an emergency man should possess. He should first of all be a practical man, one who has worked up from the bottom and actually performed the different kinds of work necessary in the laying and maintaining of water pipes and fixtures. He should have a knowledge of the location of the various lines that traverse the city, a knowledge as to their general location, the route which they take, and a knowledge as to their particular location, the part of the street in which they lie. He should know the connections with these lines, the relative importance of the lines and their connections, and above all he should know the locations of the gates controlling the lines and connections. He should be able to make quick or temporary repairs. He should be strong, of good health, sober, cool, of good judgment and discretion, a dependable man, one to whom the superintendent of a water-works system may intrust the care and safety of that system when he withdraws from the day's work and when he retires for his nightly sleep, with a feeling of confidence that matters will be handled properly in his absence.

Such a man is usually found in every large water-works system, but not in great profusion. By careful observation he may be discerned, and the wise and far-seeing superintendent noting his good points keeps him in his mind's eye, nurses him along, gives him opportunities to develop his confidence and special qualifications, encourages him to study the pipe system with its ramifications, to the end that he may know the effect of closing or opening various valves, and, when the time is ripe and the opportunity comes, the right man is ready for the place.

The tools essential to the efficient operation of an emergency force are as follows:

Heavy wrenches for the operation of large gates. These usually are made with detachable handles. T-handles are used in some

cases, and crosses or four-arm handles are used in others. The latter kind allows of a more continuous movement, it allows each man to apply his force more directly and with less wasted energy than with the T-handles, where hand room is limited and the men are more crowded in their movements. More leverage can be obtained with either handle by the use of extensions in the form of short pieces of iron pipe, or hand spikes set into sockets on the handle of the wrench. Norway iron is the best material for wrenches because of its toughness. Steel is more brittle and liable to break in cold weather. The wrench should be as short as practicable. The gate nut should be brought to a uniform distance below the street surface by means of an extension permanently attached and in place under ground. A recently made device, in the shape of a long hollow-steel wrench with an adjustable handle, appears to do away with the necessity of these extensions. The wrench is made of square steel tubing, and is long enough to reach a deeply buried gate. The handle moves up and down along the wrench column. It can be placed at a convenient height and kept in place by a pin passing through holes bored at intervals through the wrench rod. It is light and efficient.

Other wrenches lighter in make should be carried for operating the smaller size gates. It is well to have a wrench with an open socket equipped with sliding wedges. These are of much value where the stem nut is smaller than usual or where the corners of the nut have been worn smooth.

Wrenches for corporation and curb cocks, hydrants, air valves, etc., should also be carried.

Monkey and Stillson wrenches are required at times; also calking tools, driving and sledge hammers, crowbar, picks and shovels, a stiff broom, a hand pump, a long-handled spoon to remove dirt from gate boxes, white and red lanterns, and a strong light with reflector to locate gates and gate marks at night. A good light is made of a small acetylene gas tank such as was used to furnish gas for the headlights of automobiles before electric lighting became so common. A burner and reflector may be attached to the tank, and the whole outfit suspended by bands and a handle, so that it may be carried by hand and the rays of light sent in any direction. The headlights of the auto may also be utilized to a certain extent.

A gasoline or kerosene torch, such as is used by railroad men to thaw out frogs and switches, is useful in winter to thaw out frozen gate covers and melt the ice that sometimes forms in small gate boxes which fill with mud and water.

Connection pieces to replace, temporarily, frozen, leaky, and stopped meters are useful. A force pump to clear out stoppages, and other fittings that may be applied as first aid in time of trouble, should also be included.

Hip rubber boots should be furnished the men, and they should have suitable storm clothing as protection against the weather.

A useful adjunct to the equipment is a powerful lifting jack. Frequently a heavily loaded team sinks into a soft spot in the street caused by a leak, and it is good policy to assist in extricating it, thus minimizing the loss of time which will be included in the claim for damages that is certain to follow.

Plans should be carried on the car, showing the pipe system in a condensed form, at a scale of 200 or 400 ft. to the inch. These should be in the form of blueprints and kept up to date. They are of great help to the men, especially when they answer calls in new territory or in some suburban district where they are not well acquainted with the pipe lines.

A gate finder is also useful at times, especially so in cases where tarvia and other bituminous preparations are spread upon the streets and become soft and plastic and " crawl " under the rolling motion of traffic, covering the gate boxes by a thin layer. The gate finder is a magnetized needle which is deflected towards the ground when it passes over the iron cover.*

In Boston we have a more positive way of locating our gates. A distance mark is stenciled on a fence, pole, or building directly opposite the gate if possible, telling the number of feet from the mark out to the gate. If it is not possible to place the mark opposite the gate, it tells the distance between the mark and a point opposite the gate. A stenciled arrow shows the direction, right or left of the mark, that one must measure to get the opposite point. In other words, the mark gives the base and perpendicular of a right-angle triangle, the apex of the triangle being the gate. Sometimes these marks are black on white ground, other times the

* JOURNAL N. E. W. W. A., XXVIII, 294.

reverse, according to the color of the background. The object is to make them as conspicuous as possible, especially at night. When the ground is covered with snow, these marks are invaluable. In squares and intersections where there are many gates, a sign is erected on a post with the distances for all the gates tied from the one point, viz., the post. This makes unnecessary a number of marks on the corners and sides of the squares or intersections and concentrates the information at one point. The sign is not unsightly. It has gold letters on a dark-blue smalt ground, and is similar in outline and general appearance to the street name signs.

A measuring tape is a necessity in connection with the gate distance marks.

The automobile should be in the form of a truck with a specially designed body suitable for the carriage of men. The best arrangement is to have the seats run lengthwise with the body and use the space under the seats for the storage of wrenches, tools, etc. The body should be accessible from the rear by means of a hanging step. It should be a powerful car of not less than 40 h.p., preferably more, if there are hilly sections to cover, and if the city is located where the snow falls frequently and to some depth. It should have tires of ample size to carry the maximum load. It should be equipped with demountable rims and carry an inflated spare tire. The tires should be of the best quality and kept inflated to the limit at all times. It will be found that this will give better service and will prove more economical in the end. In fact, it will pay in every way to get a good car even if the first cost is high rather than to buy a cheap outfit that will fail you at the critical moment and will be in the repair shop a considerable portion of its life. It is well to have the car equipped with a warning signal similar to the fire department, viz., a bell with swinging tongue, otherwise traffic will pay no attention to your efforts to get a right-of-way.

In Boston we have an emergency car with body of special design, seats running lengthwise. Exclusive of the chauffeur, it can easily carry 14 men. It has a top with side curtains, and is fairly comfortable in the most inclement weather. The chassis is a White, 40 h.p., built in 1911, and is still doing good work with no prospect of our replacing it with a later model. The first

17 000 miles of the car cost us practically nothing except for oil, gasoline, and tires. Since then, considering the nature of the service and the severe conditions under which the car is run, it has given very good results. Twice in five years it has been overhauled, and with the exception of a spring leaf breaking, or a wheel bearing becoming loose, or a brake band wearing, no trouble has been experienced since the last overhauling. It has traveled about 37 000 miles up to date. We have among our other cars one of similar make to our emergency car, with body suitable for emergency and general department work combined. This car serves at times to take the place of the emergency car should anything happen to put that car out of service. It is a safe precaution to have another car in service to serve as a substitute for the emergency car, as, no matter how good the car may be, or how carefully it is run, there is always the possibility of its meeting with an accident.

The duty of the car as we use it in Boston is very severe. It is operated twenty-four hours a day by four different chauffeurs. It cannot choose its route, but must travel in the most direct way to the place it is summoned. The pavements may be rough or smooth, the stopping and starting frequent. Such conditions are a great strain on an automobile.

The car averages about 200 trips a month. Each trip averages $3\frac{1}{2}$ miles. As the department operates 16 additional automobiles, 8 of which are trucks, much business that would ordinarily be done by the emergency car is done by these trucks. Our policy is to keep the emergency car and its crew in quarters as much as possible, so that when a real occasion for its use arises it is on the spot ready for business, and not two or three miles away, engaged in some unimportant work that could easily wait until it can be cared for through the regular channels of business. As it is, it answers many false alarms. A plumber desirous of having the water shut off to enable him to make repairs will sometimes telephone that a pipe is broken in the cellar and is doing great damage. We hasten to the scene only to find that the owner or plumber desires the water turned on or off and he did not wish to wait to have it done in the regular way. As for damage, there was none; nor any possibility of any.

At other times during a heavy rainstorm we are called upon to stop the entrance of surface water to cellars, or the backing-up of over-filled sewers. During a recent heavy rain our office received over forty calls for assistance in one hour between 5 and 6 P.M.

We are also called upon to extricate horses from manholes and trenches into which they have fallen, and in a variety of ways are requested to attend to matters either outside our regular line or such as could not properly be classed as emergencies.

The emergency gang as operated in Boston is divided into three eight-hour shifts, each in charge of a leader. The day shift consists of four men including the leader. Each of the night shifts consists of six men including the leader. There is, besides, a man on duty in the office during each of the night shifts and on Sundays and holidays. He attends the telephone and takes all messages and notifications and directs the emergency gang to the point of trouble.

Owing to the eight-hour law, we cannot work the men more than six days a week. It is therefore necessary for each man to suspend his work one day in seven. This is so arranged that there will be but one man off on each shift each day. This practice of laying the men off one day in seven reduces the number of men available by one the greater part of the week. To offset this we were obliged to add one more man to each shift to serve as a substitute during the absence of a regular man on his night off or during his vacation. Some risk is attached to laying off the leader, as he is the most capable man, and the most serious break is likely to occur the night he is off.

Most of the calls could be attended to by one or two men, but, as we do not know when the big job will come, it is necessary to have a sufficient number of men on hand at all times to meet it. During the day it is always possible to get assistance in handling large gates, but at night it is practically impossible. Therefore, in the event of a break in the lines of large diameter with water flowing at a great velocity through the valves, it is necessary to have at least five men to close the 36-in. gates that control the same. Arrangements are made so that in the event of a very difficult shut-down, where several large gates have to be operated

against a strong head, other men on duty in the stable and fire room may be called out to assist.

A device invented by the writer has proved itself capable of great service in the operation of large gates. It is incorporated in the mechanism of the automobile emergency car and consists of a universal wrench socket actuated by a worm gear, placed within a housing on the side footboard of the car in such a position that it can easily be brought over the gate manhole in the street. When the car is in position over the manhole, a wrench is slipped through the socket and fits on the stem nut of the gate below. The universal wrench socket, together with a universal joint on the end of the wrench, affords flexibility in case the car is not on level ground or the wrench socket not directly over the stem-nut. It is an easy matter, however, for the chauffeur to bring his car into the right position. The worm gear that actuates the wrench socket is driven by a horizontal shaft leading from a gear case back of the regular transmission of the auto. This gear case encloses a sliding gear clutch incorporated in and acting directly upon the driving shaft of the car. The gear clutch has teeth on both ends, that engage with internal gears according to its position. It is operated by a lever placed upon the side of the car and easily accessible to the operator. It has three positions, — one where its rear end engages with an internal gear that turns the driving shaft of the car; one where its front end engages with an internal gear that externally meshes with the pinion of the horizontal shaft that drives the worm gear, which in turn actuates the wrench socket; and a neutral position where everything is idle. In closing gates, the forward speeds of the auto are used. In opening, the reverse is used. All gears are made of chrome or nickel steel. All bearings are ball bearings, and all parts except the horizontal shaft are housed in aluminum. The housing is firmly bolted to the frame of the chassis and well braced to resist torque. The wrench used is a hollow square steel tube terminating in a specially hardened steel socket with universal joint between socket and tube. As fast as possible, gates are being equipped with indicators showing position of valve and informing the operator when the valve is seated or entirely opened. Where indicators are not attached as yet to gates, a counter is used. It is placed on the

upper end of the wrench and records the number of revolutions made by the wrench. As a means of safety in the event of the valve seating with force, or unexpectedly, a pin of known strength, placed in the universal joint of the wrench, shears off and breaks the line of power between the engine and the gate and prevents damage to either the gate or the gate operating device.

The machine takes up little space and does not interfere in the least with the ordinary use of the auto.

We have used the device to some extent in ordinary maintenance work, i.e., the closing and opening of gates incidental to repairs and changes in the pipe system. We have also used it to a limited extent as an adjunct of gate inspection, running the valve down and up to observe its operation and to facilitate its movement. Fortunately, however, our opportunity to use it as a real emergency device has been limited to one occasion, a few months ago, when our 42-in. high-service main broke in Copley Square. An entire length of a pipe was broken out, and water under one hundred pounds pressure gushed out and spread itself over the square. The asphalt pavement, with its concrete base, served to keep the water underground for a short time, and this — together with the fact that a 20-in., a 12-in., and an 8-in. main are laid nearby — caused our men a little uncertainty as to which main was broken, and some valuable time was lost in operating gates on these lines. When there was no question that the break was in the 42-in. line, they proceeded to shut the two 36-in. gates controlling the same. They are located about a mile apart. One has a 6-in. by-pass, but the other is without one. They started on the one without the by-pass first, and in their excitement forgot to utilize the gate-closing device on the emergency car. As a result their progress was slow, as was naturally to be expected with such head and velocity against the descending valve plug. Almost three quarters of an hour had been spent on this gate when the writer arrived and directed the closing of the other gate. The machine was used, and this gate was closed in twelve minutes. We then returned to the first gate which was not completely closed, but the resistance had been so great in lowering it by hand that it seemed as if some obstruction must have been in the seat of the valve. Rather than lose any more time on it, I had a 36-in. gate

and a 20-in. gate back of it quickly closed by the machine, and after opening a blow-off in that section, the pressure was removed and the obstreperous gate completely closed.

I am confident that if the men had applied the gate-closing machine in the first place they would have quickly closed the gate, or, if not, so much so that the flow would have been throttled down to that of a 6-in. or 10-in. pipe, and they could then have closed the gates behind it and operated the blow-off and completely shut the gate. Some valuable lessons were learned from the experience, and the confidence of the men in the efficiency of the gate-closing machine increased. No great damage resulted from the break, as it had a large area in which to spread, and catch basins drained it off. It demonstrated the value of catch basins, of which there cannot be too many, and it suggested the desirability of removing sewer manhole covers as an extra means of draining off the water before it finds its way into basements and cellars.

It also suggested the importance of having a by-pass attached to every large gate, to assist in equalizing the pressure on both sides of the gate during the descent of the valve-plug.

The delay in the early moments of the break, caused by an uncertainty as to which of the several mains was broken, proves the undesirability of laying several large-sized mains in a single city street. In Boston, where the streets in general are not noted for their width, we have many cases of two and three large mains laid within narrow limits. At the intersection of Tremont Street and Columbus Avenue, we have one 30-in. low, one 30-in. high, one 36-in. low, one 24-in. low, one 20-in. high, and several 12-in. high and low service mains. In a narrow way called Chardon Street, we have laid, as closely together as possible, one 30-in. low, one 24-in. low, one 10-in. low, and one 16-in. high service main. In Tremont at Boylston Street we have one 40-in., one 30-in., and two 12-in. mains laid closely together; and branching into Boylston Street, easterly, are one 16-in. and one 30-in.; and branching westerly are 8-in. and 12-in. mains. In addition to all this, we have a new high-pressure fire-service main. In Huntington Avenue, near Francis Street, we have laid, with very little distance between, one 42-in., one 36-in., one 30-in., one 20-in., and one 12-in. mains.

These are a few examples of many similar situations, and are cited here merely to show the difficulty confronting an emergency-man in any of these locations, accompanied only by three or four helpers, at about 3 A.M. on a stormy morning with the wind blowing a gale, the ground covered with snow, sleet blinding the eyes, and a tremendous volume of water gushing from the earth, destroying the pavement, making dangerous holes here and there, and covering beyond all hope of access manholes wherein are located the valves controlling the different mains. The question that surges up in his mind is, "Which of the mains is gone?" He must have powers beyond those possessed by mortal man to decide quickly and accurately. There is nothing he can do except to approximate as nearly as he can which main has failed and then proceed to shut off that one, and if the flow continues, try another, and another, and so on until he strikes the right one. It so happens in the ordinary course of human events that not infrequently he makes the right selection last.

Another aspect of this matter of laying several mains in proximity to each other is the danger to the other mains caused by the washout from the broken one. As I said before, "disturbance" is greatly to be feared in connection with water pipes, and here we not only have a disturbance but in many cases an upheaval.

When the emergency car is dispatched to answer a call, one man is left behind at headquarters unless the notification makes it plain that a serious job is at hand. The man at the telephone can usually tell by the number and rapidity of the telephone calls. Where there is a break of large dimensions, the average citizen considers it his duty to inform the water, police, or fire department, whichever in his judgment is the proper one, and the result is an avalanche of notifications directed to the Water Department. As a rule, there is no mistaking real trouble by this sign alone.

The man left behind at emergency headquarters is available in the event of another call coming in after the car has left in response to the first call. It is sometimes the case that the gang is sent out on a trivial matter and a few minutes after its departure notice is received of a serious leak. The man left at quarters responds with a horse and light wagon, and if possible he controls the situation

himself. If it is beyond his ability, he telephones to the office. In the meantime the office man has been getting in touch with the emergency car and has in all probability directed it to the scene of the second leak. He has done so by use of the telephone. Telephones are in such general use at present that it is almost always possible to ask the occupant of a house or store in the vicinity of where the car was called to step outside and summon one of our men to the 'phone. If this is not possible, we can always reach our men through the police. The man on duty in the police station receives reports from the officers outside through the signal boxes. He communicates with the officer on whose route the car is supposed to be and has him convey to our men any directions we may see fit to give. Furthermore, it is a rule of the emergency service that as soon as practicable after arriving on a job the man in charge of the gang is to telephone the office as to his whereabouts, and the nature of the trouble, and receive instructions from the office as to his next move. In this way we save time and travel by moving the car from job to job rather than have it return to quarters after each one.

It has been customary, during the last few years, to have the emergency gang report at all large fires, the object being to render any aid that it can in connection with the water supply. In the case of a very large fire, where the supply is insufficient, it may be possible to reinforce it by opening division gates that are usually kept closed to separate high- and low-pressure systems. If the fire is in the vicinity of the boundary line of the city, gates may be opened admitting the supply from some adjacent town or city. If a hydrant becomes inoperative, it may be possible to make it serviceable; or if a hydrant breaks away from its fastening, gates may be operated in such a manner as to stop the flow of escaping water without interfering with the supply of the other engines. Pipes of large size entering buildings on fire usually break off inside the building as the fire progresses and the building collapses. Unless these pipes are shut off the pressure in the mains is decreased to a point where the efficiency of the fire department is imperiled. In many such cases the emergency gang is of value in shutting off these pipes in the street. Modern practice requires the presence of skilled water-service men at a large fire for

the same general reason as that which requires the presence of gas men, electric-light men, telephone men, and street railway men.

As we look back over a period of years, the wonder is how we ever managed to attend properly to the troubles of a large water system without the assistance of a well-organized and rapidly-moving emergency gang. We find somewhat of an explanation in the following facts: that the public did not expect such prompt and efficient service as it does to-day; that the public was not so prone to exact damages for the slightest wetting of its property; that litigation was not entered into so cheerfully and freely over the merest pretext as to-day; that pipes were not so old; that they were laid with more thoroughness and less haste than to-day; that they were laid under better conditions, with more room and less occasion for crooked lines; that there was practically no disturbance to the pipes or their surroundings once they were laid; that there is higher pressure as a rule in the pipes now than formerly; that there are more pipes and larger pipes; that modern plumbing is of a highly complicated and elaborate type, involving a greater and more constant supply; that there are more hydrants and of a type that project above the surface of the street; that there are thousands of automobiles moving at a quick pace throughout the streets day and night; that there are reckless and irresponsible drivers operating these automobiles; that the automobiles under the influence of such drivers come in violent contact with hydrants, the consequences being obvious to the water-works man; and that in general, modern civilization, as it is found to-day in large cities with its virtues and vices, its characteristics and methods, its utilities and luxuries, makes the emergency gang in a water service a fixed necessity just as the ambulance and relief hospital are established adjuncts of the regular hospital; as the automobile fire apparatus has superseded the old hand- and horse-drawn engines; as the automobile police patrol has replaced that crude, exhausting method of dragging the drunk through the streets to the police station; as the powerful and luxurious trolley has replaced the stagecoach and horse car, and so on throughout all lines of modern life.

The well-organized and properly-conducted emergency service in a water department of any large city of to-day is a valuable

asset. Beyond its efficiency in its own special line, whereby it saves money by minimizing property losses and public inconvenience, it serves as a stimulant to the department of which it is a part, to keep its system up to a high standard of efficiency. The emergency gang in the course of its regular work is constantly uncovering weak spots in the system. A gate is found defective, covered up, or the box filled with mud. A hydrant is found out of order and in such a condition that it cannot be used at a fire. Service connections are found to have no shut-offs or else defective ones. The absence of a gate mark is noted. The need of more gates on certain lines is shown; the advantage of a blow-off here or an air valve there, and so on.

A smoothly-working emergency service implies a water system with its fixtures in good working order. While the mechanical elements of an emergency outfit are an essential part of the same, yet the factor of prime importance, in that as in all lines of public service, is the human element. If that is of high standard, the rest will rise to the same level almost automatically.

To have the personnel of not only our emergency service but of all branches of our water works of a high moral, mental, and physical standard should be the constant aim and effort of every waterworks man holding an official position of high or low degree.

METER RECORDS FOR SMALL WATER WORKS.

BY A. W. F. BROWN, SUPERINTENDENT, FITCHBURG, MASS.

[*Read September 15, 1916*]

From our experience, the three forms submitted have been found to supply the needs of recording the service given by a meter and furnish information that will help to settle the problem of the best meter for a place to use.

Form A is used for all tests of meters, and, as it can be filed in a loose-leaf binder, saves the extra work of copying the tests. The test slip is filed under the size, make, and number of the meter, and all subsequent tests of this same meter are filed with the first one, so a complete record of the service of the meter is had at any time from these slips.

Form B consists of two slips, a white and a pink duplicate, which are filled out in the office, and the white one is given to the meter men to install a new meter or change an old one. When the meter is set, the slip is filled out and returned to the office and the pink one is filled out to correspond. The pink slip remaining in the office gives a record of the meters unset, and, if those given to the men should be lost, furnishes the names for a new list. It is easy at the end of the year to take the data needed to figure the service for Form C from these slips by sorting the different makes and sizes together, after which the slips are filed in a binder for any further reference that occurs.

Form C, a card 5 in. by 8 in., is an effort to figure the make of meter that is giving the best service, all things considered, and, by actual costs, brace up the opinion that one has formed of the best meter to use. The costs of the repairs on each make and size can be filled in during the year from the bills for repairs, and the totals of cubic feet registered and length of service are obtained from the Form B slips at the end of the year. The expense is so divided up under these headings that a clear understanding of the service of your meters is before you at any time.

Form A.

If this is first test of new or repaired meter, fill in column No. 1; if not, use column No. 2, or No. 3.

Size of Streams.	Per Cent. of water delivered into tank. TESTS. No. 1.	No. 2.	No. 3.	Feet Run.	Pressure at Outlet.
4″					
3″					
2½″					
2″					
1½″					
1″					
¾″					
½″					
⅜″					
¼″					
$\frac{3}{16}$″					
$\frac{5}{32}$″					
⅛″					
$\frac{7}{32}$″					
$\frac{1}{16}$″					
$\frac{1}{32}$″					
Average					

Fitchburg Water Works, Meter Test No. _____

From _____

_____ Street

Make _____ Size _____

No. _____ Reading _____

New _____ Old _____ Repaired _____

Date test No. 1 _____ No. 2 _____ No. 3 _____

Read test No. 1 _____ No. 2 _____ No. 3 _____

Test No. 1 Makers; No. 2 bef. clean; No. 3 aft. cleaning

Clock speeded up _____ Inter. gear _____

Stuffing box _____ tightened _____ repacked

Parts broken _____

Ft. run in ser. since test No. 1 _____

Removed from ser. because _____

In service, Years _____ months

Disposition of Meter _____

_____ Inspector

Form A.

Form B.

Meter Orders

FITCHBURG WATER WORKS

Mr. _____

_____ Street

Reason _____

Date of order _____

NEW

Size _____ Make _____

No. _____ Read _____

OLD

Size _____ Make _____

No. _____ Read _____

Date of Setting _____

FORM C.

Size | **Make** | **Repair Card**

D. of R.	T. N. M. in S.	T. N. M. R.	% of M. R.	T. C. of R.	C. R. per M. S.	T. first C. M. R.	% of R. to first C.	T. N. M. O. R.	T. C. O. R.	C. per M. in S. O. R.	T. N. M. frozen	C. of R. frozen M.	C. per M. in S.	T. N. dam. by heat.	C. of R. by heat.	7	8	Av. L. of S.	T. duty performed cu. ft. reg.	C. of R. 1 000 cu. ft. reg.	Av. F. C. of M. to D.
		1	2	3	4	5	6											y. m.	9	10	11

Total number of meters in service figured only on this size and make. Abbrev.: Av., average; C, cost; D, date; F, final; L, length; M, meter; N, number; O, ordinary; R, repairs; S, service; T, total. No. 7, N. M., worn out, spoiled or exchanged. No. 8, net cost of replacing No. 7 with new meters and is figured in Nos. 1–2–3–4–5–6–9–10–11. Nos. 1–2–3–4–5–6–9–10–11 include cost of repairs caused by frost or heat.

A SUGGESTION THAT THE ASSOCIATION APPOINT A COMMITTEE TO PREPARE STANDARD SPECIFICATIONS FOR WATER METERS.

BY ROBT. J. THOMAS.

[*Read September 15, 1916.*]

Should the New England Water Works Association appoint a committee to prepare standard specifications for water meters, as they have for cast-iron pipe and fire hydrants? That this is "some" question is fully appreciated, but, whatever the answer may be, it is believed its discussion will not prove unprofitable. Considerable money is expended in the purchase of meters, and cost of repairs is an important item.

If the superintendent of a municipally-owned plant could go into the open market and buy the meter which his experience shows to be, in the long run, the best and cheapest, then — provided his conclusions are based on actual test and repair records and are not simply the result of a predilection for some particular sales force — the purchase of meters would be logical and simple; but these conditions very seldom obtain at the present time.

Instead of this, in many cities and towns, ordinance requires the obtaining of bids and the awarding of the contract to the lowest responsible bidder. Under such conditions specifications are necessary, and, to any one who has examined those now in use, it is clearly evident that here is an opportunity for this Association to be of service. A great majority of present specifications contain simply a few broad requirements which all meters can meet —the bidders being generally requested to submit a description of the materials used, the weight and the greatest proper capacity of the meter. Frequently no statement is made as to the rate of testing, general accuracy, or sensitiveness. Sometimes it is stated that tests will be made with streams of certain diameters, but without expressing the test pressure, which is about the same as saying that a linear dimension shall be as long as a piece of string.

Almost never is anything specified as to the maximum allowable loss of head for certain discharges, and yet in many cases the loss of head through a meter may determine whether a good stream can be supplied on the higher levels of the distribution system, and some $\frac{5}{8}$-in. meters have no more loss of head for a certain flow than other $\frac{3}{4}$-in. meters. Again, the rates under which tests are made and the accuracy required differ widely and are not expressed in the same terms. Finally, little or nothing appears, in any specification which has been available for examination, that covers maintained accuracy or sensitiveness after use, which is really the most vital consideration, and there is small indication in any of the specifications that actual repair-shop records have been made the basis of requirements covering the method of constructing the meter. In some few specifications, the number of nutations is limited, and, in some, reinforcement of the disk or the use of a thrust roller is required.

It would seem, therefore, that this field of meter specifications might be profitably cultivated by this Association.

The best information for determining the specifications necessary for the best results is presumably to be found in department test and repair-shop records. Here, if anywhere, can be found the data to show the factors essential to durability, low repair cost, and maintained accuracy; and apparently one of the first steps towards the development of rational specifications is the collection and comparison of these records. The durability of meters as shown by shop records should never be lost sight of. For, no matter how easy a meter is to repair, if those repairs occur frequently, considerable revenue is lost by failure to register, not to mention the friction which is bound to arise between the office and the water taker in consequence of interrupted service.

How much more do we superintendents know about meters to-day than we did in 1895, when John Thompson presented a paper before this Association, and Clemens Herschel proposed that we conduct tests of meters? Does reinforcement of the disk or a thrust roller actually reduce breakages without loss of accuracy at low flows? Is depreciation more rapid with increased rate of nutation? Does the straight reading dial, with its mutilated gear-train, increase friction and so lessen sensibility? In

general, what are the construction features necessary to long life of meter, low repair cost, and maintained accuracy? Who can answer these and many other questions of practical import by reference to the records of his testing plant and repair shop? A record of meters taken out, maintained by a department for several years, showed 6 per cent. to 15 per cent. stopped or taken out yearly.

It would seem that this Association might profitably undertake the collection of the records of meter repairs and of tests made of meters when new and after certain periods of use. This is not a suggestion that this Association test meters, but rather that it collect by circular a digest of the information already in the repair shops and test records of many departments; or, if such records are not now in workable shape, that some standard form of keeping and reporting the information necessary to the determination of the relative durability and continued accuracy of meters be developed and adopted for use by the members of this Association.

It is fully realized that local conditions vary, and that the controlling factor in the life history of a meter is the character of the water, but the average of results obtained from many water systems, especially since the quality of the water served has been generally improved, could not fail to show relative durability and relative continued accuracy, and from such a digest of present or future records, it should be possible to devise standard specifications which would justify the acceptance of the lowest bid offered.

In the meantime, and before such records could be collected and digested, it is believed that a tentative meter specification might be developed from a study of existing specifications. This specification could at least standardize requirements for accuracy and the method of testing and would be of considerable value.

I suggest for your discussion the appointment of a committee to consider and report on the feasibility of a standard specification for water meters, and on the advisability of attempting the collection of test and repair records in such a way as to determine, so far as possible, the relative durability and continued accuracy of meters.

DISCUSSION.

MR. THOMAS. I have some reports here, taken every year for five years, of different meters in use in the city of Lowell, where there are over 10 000 meters in use; and, taking a type of meters of which at least 100 are in use, I find that the first year, in 1907, 7 per cent. of this meter, which we will call No. 1, were taken out for repairs; 1908, 6 per cent; 1909, 7 per cent.; 1910, 8 per cent.; 1911, 7 per cent. Those meters had been in use a good many years, some of them for twenty-five years.

Another meter, we find 8 per cent. were taken the first year, 8 the second, 9 the fourth, 9 the fifth, and 9 the sixth, showing an improvement in the running of the meter.

We found another meter, the first year, had 14 per cent. taken out, 14 the second, down to 7 per cent. taken out the last year the record was kept. We have another meter which showed 12 per cent. the first year, 6 the second, 6 the third, 7 the fourth, and 3 per cent. the last year, which was a very good showing.

We have a meter of another make, but of about the same type, of which 11 per cent. were taken the first year, 21 per cent. the second year, 4 per cent. the third year, 7 per cent. the fourth year, and 14 per cent. the fifth year.

That, of course, gives no idea of the cost of repairing the meters. It was only to get a line on the meters that were the most constantly in use, the meters that you could rely on from year to year, — and of course that is an important factor; and we could not lose sight also of the expense of repairing the meters. A meter that will remain in use ten or fifteen years without any attention seems to me to be a better meter than one that will have to be taken out if only slight repairs are made on it, every two or three years.

There are a good many things to be considered in regard to the meter business. The percentage of registration which takes place on a meter which may be otherwise reliable and may be in use and may be giving results in the way of registration, but still there is a percentage of registration which may be far below perfect. However, my interest in this is all impersonal. I have not favored any meter, but I am anxious to see all the material that we use determined by standard if possible, especially in

view of the practice of commission governments to call for bids and oblige you to accept the lowest one. We all know that in some cases the lowest-priced article is far from being the cheapest in the long run, and if we are going to call for bids and purchase in accordance with the lowest bid we want to have the strictest kind of specification, so the city will get value for the money that they expend.

MR. A. W. F. BROWN.* I have with me a few figures of what the cost of repairs has been for one year, taking in all kinds of meters; in fact, probably every make that is in general use:

Total number of meters in service	2 357
Total number of meters repaired	334
Total cost of repairs	$1,110.00
Cost of repairs to meters in service	.47
Total number of meters, ordinary repairs	260
Total cost of ordinary repairs	$647.00
Cost per meter in service, ordinary repairs	.27
Total number of meters frozen	20
Cost of repairs	$63.60
Cost per meter in service	.026
Number damaged by heat	7
Cost of repairs to meters damaged by heat	$22.75
Total duty performed, in cubic feet	9 028 500
Cost of repairs per 1 000 cu. ft. registration	.122

MR. BERTRAM BREWER.* The speaker had quite an experience, a year ago, in Waltham, in connection with buying meters. Up to this time the city had bought meters of various manufacturers, perhaps 100 of each. It seemed very necessary to reform the scheme and make sure that the city had as many of one kind of meters as possible. I suppose every superintendent of water works is up against that problem. Up to that time, we had about a dozen or fifteen different kinds of meters. We all know what it means to keep repair parts for that number. Tentative arrangements had been made to buy six or eight different kinds of meters for the year 1915, so it is easy to see that it was no small problem to decide just what to do. As one might conclude, the fairest and squarest way seemed to be to prepare specifications. It was the

* Registrar and Superintendent Water Works, Fitchburg, Mass.
* Superintendent of Sewers and Water Works, Waltham, Mass.

first time it had ever been done in the city, but we did it, and we received very satisfactory bids, and the manufacturers went out of their way to help us.

The point I was going to make was this: from what study we gave to the situation, it did not seem possible to buy the meters on the dollar-and-cent basis alone. One would never think of buying an automobile or any other machine on that basis, and therefore our specifications required two conditions, and we awarded the contract on the basis of the price, the quality, the workmanship, and makeup of the machine. We required everybody to submit a sample of the meter that he bid on, and the samples were very carefully analyzed by an expert, and, with all the facts before us, which were written down and given to the bidders who wanted them, we came to a very definite conclusion, and our results were very satisfactory, we think; and we ordered quite a number of meters of one kind, so we hope that the repair parts will not have to be of such large quantities as time goes on, if this policy is continued.

We also adopted a scheme of keeping records of the meters — the first time it had ever been done with us. Our meter sheet is rather simple (see Figs. 1 and 2). We put all the data on one sheet,—the test, the service in which the meter is installed, and the data that it was installed. We also have dates and lines in the sheet provided for the reading of the meters. Of course we always read the meter for the first week or two after it is installed, and keep the customer informed as to the condition or the use of water, especially if there is any waste. All these records, also the cost of installation and the cost of any repairs, are kept on these sheets, and they are filed away according to service numbers. I think this idea of records and a uniform system of keeping those records is a very important matter, and perhaps has not been emphasized enough. It seems to me it is just as important as the matter of the specifications, because, if one superintendent keeps the record one way and one another, it is very difficult to compile those records in such a way as to make them of any use.

Another point occurred to me that it is very difficult to dogmatize the suggestions, such as have been read to us to-day, about the number of repairs, or the percentage of meters that have been

JOB NO.....

WALTHAM WATER DEPARTMENT.

DAILY LABOR, PLANT, MATERIAL RECORD.

Date.	Laborer (or Plant).	Rate.	Hours.	Amount.	Total.	Remarks.

Date.	Material.	Unit.	Unit Cost.	Number.	Amount.	Total.	Remarks.

CORRECT.....FOREMAN.

FIG. 1.

This side is used for data on first cost and maintenance of meter.

WALTHAM WATER DEPARTMENT.

INSPECTION REPORT.

Date	

METER TEST: SIZE.....NAME.....NO.....

Date.	Pressure Pounds.	Opening Inches.	Time.			Register Readings, Cu. Ft.			Percentage of Error.	Rate of Flow C. F. M.
			Start.	End.	Difference.	Start.	End.	Difference.		

CORRECT.....FOREMAN.

FIG. 2.

Reverse side of sheet is used for record of all inspections of metered service and for record of meter tests.

repaired from year to year, because there are a good many repairs of that kind that have to be made that cannot be charged up to the meter. The hot water and the connections often cause a great deal of trouble with the meters. Then we have trouble with dirt collecting in the meter. Those are two things which occur to me which cannot be exactly charged up to the meter itself, as the fault of the mechanism, and there may be others.

MR. SHERMAN. In order that the matter may not drop, and that we may have some definite subject to talk about at the moment, I will make the motion suggested by Mr. Thomas's paper, that the Association appoint a committee to study into the desirability of formulating meter specifications.

MR. KING. I would like to amend the motion, in line with one suggestion Mr. Thomas made; that is, in line with the standardizing of the main parts, that the committee make an effort to standardize as many of the parts as possible.

MR. SHERMAN. I accept the amendment.

The motion as amended was carried by a unanimous vote.

The President subsequently appointed the following committee: Charles W. Sherman, Boston, Mass., chairman; A. W. F. Brown, Fitchburg, Mass.; R. J. Thomas, Lowell, Mass.; William W. Brush, New York; James H. Mendell, Manchester, N. H.; Charles A. Finley, Pittsburg, Pa.

LEAKAGE FROM PIPE JOINTS.

BY F. A. BARBOUR.*

[*Read September 14, 1916.*]

On September 7, 1915, — as a result of a paper read by Mr. Arthur H. Smith before this Association, — a committee was appointed " to investigate experience in the leakage of pipe joints." This committee consists of Messrs. C. E. Davis, S. E. Killam, C. M. Saville, H. B. Machen, A. H. Smith, E. G. Bradbury, and the writer.

The present brief statement is not a progress report from the committee; rather it is made for the purpose of inducing a more active interest in the investigation by the members of the Association, and particularly with the hope that a discussion may result which will be of value in the further work of the committee. Any opinions expressed are the personal views of the writer and not of the committee.

As the best method of obtaining the results of experience in joint leakage, a circular containing 37 questions was mailed to 430 members of this Association, and to 124 members of the American Water Works Association. From the 554 circulars sent out, 131 replies have thus far been received, 46 of these being from the members of the American Water Works Association. Only 85 replies were received from the 430 circulars sent to the members of the New England Water Works Association. When only one in five members takes any notice of such a circular it is evident that either the subject of the investigation is of little moment, or else the members do not appreciate the value of cöoperation if any results of value are to be obtained.

It may be — and in regard to this it is hoped that members will to-day express their opinions — that leakage from pipe joints is not generally an important factor, and that the present type of joints driven and tested, or not tested, as may be the practice, is entirely satisfactory. It also may be, and probably is true, that such leakage from mains as does occur is not general, but is rather located in a few imperfectly-made joints; or, in other

* Consulting Engineer, Boston, Mass.

words, that the average present standard design and workmanship is good enough. While this may be true, it comprehends the subject chosen for investigation, and thus far little information of definite value in reaching any conclusion has been received by the committee.

One fact, however, stands out, namely, that even in the fully metered systems, about 20 per cent. of the total water supply is unaccounted for by sale to the consumers. Thus of the 131 replies received, 10 per cent. report the services to be entirely metered and 30 per cent. more than 85 per cent. metered, and the average water unaccounted for, as estimated in these systems, is 21 per cent. This loss is chargeable to leakage from mains or services, or to failure of the meters to register. It would seem to be worth while attempting to locate the cause of a 20 per cent. loss of the water furnished. If slippage of meters is the explanation, this simply means that consumers are getting more than they are nominally paying for, but, if leakage from the mains and services is responsible, the result is an absolute loss of water which costs money to develop and deliver to the distribution system.

The average consumption in the 40 systems in which 85 per cent. or more of the services are metered is, as reported, 68 gal. per day per capita. The average estimated unaccounted-for water was, therefore, equivalent to about 14 gal. per day per capita, or a loss of 5 000 gal. per year per capita, which, if the cost is estimated at $25.00 per million gallons of water delivered to the distribution system, is equivalent to a yearly cost per capita of 12½ cents, or approximately the interest on $2.00; in other words, a town of 10 000 people could afford to expend $20 000 in order to prevent this loss of 14 gal. per day per person.

If, then, in these fully metered systems, which undoubtedly represent the best condition, only 80 per cent. of the water supplied is sold to the consumers, the question arises as to whether this should be accepted as the highest standard of efficiency which can be reasonably attempted.

If, in any considerable part, the unaccounted-for water is chargeable to slippage of meters, then it would seem desirable that increased attention should be given to the subject of maintained accuracy and sensitiveness of meters.

If meter slippage is not the explanation of the unaccounted-for water, then the loss must be through leakage from the mains or services.

As to the loss from services, 80 per cent. of those replying to the circular estimate this to be small or none. As to the leakage from mains, 99 of the 131 answers received do not attempt to estimate this loss; 18 state it to be very small or none; and 14 estimate it in percentage of the total amount supplied, the average of these few figures being 15 per cent.

From the replies already received, therefore, — and these presumably are from those departments best able to answer the several questions, or most interested in the problem, — it is evident that, while undoubtedly a considerable portion of the water supplied is not sold to the consumer, there is little or no definite knowledge of the actual conditions of the pipe joints. The general impression, as indicated, is that the mains are fairly tight and that the leakage from services is small. It may also be inferred, from various notes in the replies received, that such leakage as may occur in mains is located at certain isolated joints and is not general.

One phase of the investigation as conceived by the committee was that in reference to the practice of testing pipes when laid. Believing that in the majority of cases local conditions would not permit the trenches to be kept open until the pipes were tested, the question was asked as to the reasonable allowable leakage in testing after backfilling, as determined by the measured water necessarily introduced to maintain the test pressure. Such a method of testing is of course not to be compared with the visual examination of the joints under pressure, but it is necessary in many cases.

Of the 131 replies received in reference to testing pipe when laid, 76 state such tests are made, 36 that no tests are attempted, and 19 that sometimes the pipes are tested and sometimes not. The interesting and rather surprising feature in these replies is that all but six of those who state that the pipe is tested report that the test is made before backfilling the trench. Further, of the 75 who replied to the question as to the standard of tightness required before putting the pipe in service, 63 state this require-

ment to be "absolute tightness." Of those who report that it is customary to test the pipe when laid, 85 per cent. state that the test is made under the working pressure which the pipe is to carry in service. Only 18 report tests in excess of working pressure, the test pressures ranging from 30 lb. excess to double the working pressure.

From the information received to date, it therefore appears that it is quite the general practice to test before backfilling and to require absolute tightness under the working pressure. If these replies can be accepted as expressing the general practice of water departments, it is evident that the present standard is high, and the only question which might profitably be asked is as to what happens to the joints when the higher pressures due to water ram, and more or less incident to the operation of every system, are applied, and whether, therefore, pipes should not be tested at some pressure above that of working conditions. It is noticeable that but very few of the statements made in reference to leakage from mains and services are based on any actual tests after the pipes have been in use for any period of time, and the opinions expressed are generally formed from observation of such joints as have from time to time been exposed. Only four definite statements of tests for leakage of pipe after periods of use are reported, and these indicate only a small loss from the joints.

Naturally, only those systems where a high percentage of the services are metered can make any accurate estimate of the water not delivered to consumers. Where less than 75 per cent. of the services are metered, waste by carelessness inside the premises of consumers is undoubtedly the great factor in determining the amount of water supplied — a condition which clearly stands out in the replies received, by comparing the water furnished per capita with the per cent. of metered services. Thus, with due allowance for special industrial demands, the relation between meters and amount supplied is very approximately as follows:

100 per cent. metered, 68 gal. per day per capita.
75 " " " 75 " " " " "
50 " " " 90 " " " " "
25 " " " 110 " " " " "
0 " " " 125 " " " " "

It is therefore evident, as would be expected, without the evidence of the present investigation, that, in the conservation of our water supplies, metering of the services is the great factor, and leakage from mains, except in particular instances, is of minor importance.

While this is true, however, there remains the fact that in completely metered systems the average unaccounted-for water amounts to about 20 per cent. of the total amount of water delivered to the distribution pipes.

Whether it is economically possible to reduce this loss by a better type of joint, better workmanship, testing at pressures above normal, cannot be determined by the evidence thus far made available to the committee. The information most needed to reach conclusions is that giving the results of leakage surveys, of actual tests made after the pipes have been in service some years, of experimental work showing the relation between pressure on the joints and leakage, and, particularly, data from those departments where accurate tests have shown leakage in mains to exist. There is no doubt that in many cases there is a large loss from the pipe system, even though in the replies received to date to the circulars of the committee the great majority regard this loss as very small, or refuse to make any estimate.

The object of this brief preliminary consideration of the subject is to ask that members who have not replied to the circular do so at once, and particularly that any member who has at hand the results of definite leakage tests submit such information, which will of course be considered confidential.

An expression of the opinion of members on the general question as to whether further investigation of joint leakage is worth while would be of considerable interest.

DISCUSSION.

MR. BARBOUR. The object of presenting this paper is to bring it to the attention of the members. The New England Water Works Association is in the habit of creating committees, perhaps too many of them. After they are created, the interest falls off. The committee cannot get any results without coöperation. As strongly as I can put it, I hope the members who have not replied

to that circular will do so, and particularly the men who have knowledge of leakage from pipe will tell us the results of any special investigations that have been made. Either that, or we have to assume the investigation is not worth while, and we might just as well drop it, and the committee so report.

Discussion at Meeting of November 8, 1916.

Mr. Barbour. This paper was written to stimulate discussion, with the hope that more definite data would be made available for the Committee on Leakage, rather than with the idea that it contains much information of definite value. Any conclusions which have been drawn from the information already furnished the committee are largely confirmatory of results which have been reached by other investigations.

The fact that in entirely metered systems, or in systems where the meters exceed 85 per cent. of the services, at least 20 per cent. of the water furnished is, on the average, unaccounted for, does, however, stand out, and the question arises as to whether we should be content with such a condition. It is to be noted that this 20 per cent. loss is not based on a comparison of pump records with the water sold, but on the figures furnished by superintendents as to the water unaccounted for in their systems, these figures presumably making corrections for such items as pump slippage. It would seem that a loss of 20 per cent., due to leakage from mains and services or to under-registration of meters, which undoubtedly represents the best conditions, is sufficiently sizable to justify careful consideration of possible remedies.

We all know that the total unaccounted-for water in unmetered systems is enormous; presumably we all agree that metering is the great remedy, and yet, as reported by the United States Department of Commerce, only 40 per cent. of the services are metered in 201 cities, containing 26 000 000 people and having an average per capita consumption of 139 gal. per day. This total loss is not the subject of our immediate discussion, but, as a means of calling attention to present standards of management, a few figures may not be amiss.

The total population in the United States supplied with water from public works may be taken, for present purposes, at fifty

million people, and the average amount of water furnished per day at 100 gal. per capita. The total water supplied daily by public works is, therefore, in round figures, 5 000 million gallons. It is probably a safe statement that 50 per cent. of this quantity is wasted, and assuming the actual cost of furnishing the useless 2 500 million gallons to be $25 per million gallons, — and this is an extremely low figure, — the cost per day of the water wasted is equal to $62 500, or $22 800 000 per year, which is equal to the interest on an investment of $500 000 000. Figured in this rough way, the results do not speak very well for our present-day standard of management of water systems. If it should be answered that it is not practicable to prevent this loss, a reasonable reply would be that at least we should know more about its causes than apparently is known at the present time.

As already stated, metering is the great means of reducing the total waste on which the previous figures are based, but there remains the fact that in the fully metered systems, on the average, at least 20 per cent. of the water furnished is unaccounted for, and probably if more accurate data were available, this percentage would be shown to be materially greater.

Emil Kuichling estimated 2 500 to 3 000 gal. per mile per day as the leakage from well-laid mains; Dexter Brackett estimated a leakage of from 10 000 to 15 000 gal. per day in the Metropolitan District; and John R. Freeman stated that his best guess of the underground leakage in New York was from 25 to 35 gal. per day per capita, equal to from 20 000 to 30 000 gal. per day per mile of pipe. In six cities, with 95 per cent. of the services metered, reported by Brackett in 1904, 36 per cent. of the water was unaccounted for, equal to an average loss of 11 300 gal. per mile of pipe. James H. Fuertes, in the 1906 Report to the Merchants Association of New York, presented statistics from thirteen cities in which on the average 82 per cent. of the services were metered, which showed that 31 per cent. of the supply was unaccounted for, equivalent to approximately 18 000 gal. per mile of pipe. What part of these losses are chargeable to the mains is unknown, but from the results of such leakage surveys as have been made, and from the reported actual losses discovered in some cities, it is probable that 7 500 gal. per mile of pipe per day is a conserva-

tive estimate of the water lost by leakage from the 60 000 miles of mains now in use in the public supplies of this country, or 450 million gallons daily. At $25 per million gallons, this is equal to a daily loss of $11 250, or $4 110 000 per year, or the interest on $100 000 000. In the light of this economic waste, it would therefore appear that the subject of leakage from mains is worthy of careful consideration.

The Committee on Water Consumption of this Association reported in 1913 * that "in general it may be said that if in a well-metered system the water unaccounted for does not exceed 25 per cent. of the total pumpage, the practice is good." Doubtless this should be interpreted to mean that a 25 per cent. loss is good compared with the average present practice; but is it good compared with the standard which should be set up in this age when we hear so much about conservation? Should we complacently accept a loss of 25 per cent. as inevitable, and, if this loss cannot reasonably be much reduced in the systems already constructed, what about the possibility of better methods of construction in the pipe to be laid in the future? It is, of course, out of the question to consider the relaying of present systems, or to do more than make leakage surveys and check the larger losses; but, in the light of present knowledge, is it not time to seriously undertake an analysis of the causes responsible for the present large percentage of water unaccounted for? If these losses are chargeable to under-registration of meters, then this should be definitely made known, and consideration given to the possibility of developing more sensitive or more accurate measuring apparatus.

Are we taking sufficient care in testing pipe for watertightness when laid? About 60 per cent. of those replying to the circular of the committee state that the pipe is tested when laid, and all but six make the test before backfilling. In the writer's experience, testing before backfilling in the ordinary work of laying distribution systems is rare, and it is undoubtedly from the practice of simply turning on the water without any test that a considerable part of the present leakage develops. The standard of those who test, as indicated by the replies received, is "abso-

* Journal N. E. W. W. A., XXVII, 29.

lute tightness," but in the writer's experience this result is not easy to obtain, and only possible where the joints are gone over several times after the pressure is applied.

Where pipes are backfilled before testing, the allowable leakage, as determined by such test, has varied greatly in different specifications. John H. Gregory, at Columbus, made the limit 500 gal. per inch-mile per day. At Akron, 200 gal. per inch-mile per day was specified, while actual results at Akron showed about 70 gal. per inch-mile per day. E. G. Bradbury, in his paper before this Association in 1914,* proposed 100 gal. per inch-mile per day as a reasonable standard for the allowable leakage in testing after backfilling, and he figured that the difference between 500 and 100 gal. per inch-mile per day, estimating the cost of the water at $25 per million gallons, would equal a yearly cost for water lost in a city of 100 000 people, of $5 256, or; in other words, the city could afford to spend $470 per mile in order to save 400 gal. of leakage per inch-mile per day.

Again, are the present jointing methods the best qualified to maintain tightness after periods of use? Who knows anything about the comparative leakage when laid and after several years? In this latter connection the history of the work at Grandview, Ohio, is of interest. As reported by Mr. Bradbury, the supply is measured by a tested meter and all service pipes are metered. The 5.5 miles of pipe originally laid were tested before backfilling, and the leakage before any connections were made amounted to .31 gal. per inch-mile per day, or in other words, the system was practically watertight. Subsequently 0.9 miles of additional mains were laid, and gradually in the four years since the date of original construction the services have increased to the present number of 205. Either by less careful work in the extension or by depreciation of the original work, or by under-registration of the gradually increasing number of meters, the unaccounted-for water has increased until at the present time it averages about 150 gal. per inch-mile per day. An interesting feature in connection with these records is that the unaccounted-for water, based on three years' observations, averages 60 gal. per inch-mile per day during the six months from October to April, and 213 gal. dur-

* JOURNAL N. E. W. W. A., XXVIII, 315

ing the six months from April to October. In other words, the records indicate in this system that the unaccounted-for water is three times as great during the summer as during the winter months. Whether some local explanation can be found for this result, or whether it is a reasonable result of temperature changes is not known, but data from other systems showing the unaccounted-for water during periods of varying temperature would be of considerable interest.

Any information of definite tests of leakage from observation of mains after periods of use, or of the effect of temperature on leakage, or the results of tests of leakage from lead joints with different shapes of bell and spigot or of other types of joints, will be of value to the Committee on Leakage, and it is hoped that if any members have such information, and are not prepared to discuss the subject to-day, they will forward it to the committee.

MR. CHARLES W. SHERMAN.* When the committee's circular of inquiry was received, it did not seem to me that I had any data which would be of use to the committee. Mr. Barbour's paper has suggested a new line of thought and that data indicating more or less perfectly the causes of loss in a fully metered system are also of significance.

These notes relate to the experience of the town of Belmont, Mass., a residential community of 8 000 people, with no manufacturing, but where there is a considerable use of water by market gardeners. The water supply is obtained from the Metropolitan Water Works, and is metered at the town line, where it is furnished into the distribution pipes. The distribution system consists of 31.5 miles of main pipes 2 in. to 12 in. in diameter, and 14.75 miles of service pipe, with 1 430 services. It has been fully metered since 1898. The daily consumption for 1915 averaged 52 gal. per capita.

Not only are all the services (including municipal buildings) supplied with meters, but there are meters on watering troughs, etc., and the water department furnishes a man and a meter to measure the water used for sewer flushing. In fact, practically all the water used is metered, except that drawn from fire hydrants for extinguishing fires.

* Of Metcalf and Eddy, Consulting Engineers, Boston.

The proportion of the water supplied, which has been thus accounted for, has been as follows:

	Per Cent.
1908	67.2
1909	65.6
1910	58.5
1911	61.0
1912	62.3
1913	64.2
1914	71.9
1915	82.5

No definite data are available to indicate where the water unaccounted for goes. In 1910, following the decrease in the proportion for which we could account, it was thought that there must be considerable leaks in the main pipes, and great pains were taken to find such leaks. These efforts did not meet with much success. Some leaks were found, but none of material consequence, and, as shown by the percentages, the gain in the next three years amounted to only about 5 per cent. It was then concluded that greater care in looking after house meters might show a further gain. Previously they had received good ordinary care; they were supposed to be read monthly, and it was believed that a meter could not be stopped or in bad condition for any considerable period without discovery. However, beginning with 1914 a systematic following up of all meters was undertaken, and no meter was allowed to stay in service more than a certain limited time without removal, testing, and cleaning. This policy resulted in a gain of 7 per cent. in the water accounted for in the first year, and a further gain of 11 per cent. in the following year. How much more gain can be accomplished in this way, we do not know, but we are inclined to believe that not over 10 to 15 per cent. of the water supplied is lost through main pipe leaks, and it may be possible to account for between 85 and 88 per cent. of all the water supplied.

In this connection it may be interesting to note that in 1915, in the high-service district of Belmont, — a section including about two miles of 6-in. and 8-in. pipe (on a portion of which the pressure exceeds 160 lb. per square inch) and 47 services,— the per-

centage of the water supplied which was metered to consumers was 94.

Our experience here leads us to believe that with good work on the main pipes, the loss from joint leakage should not exceed 10 to 15 per cent. of the consumption; if the service meters leave more than this percentage unaccounted for, it is probable that the greatest gain can be made by close attention to meters.

This does not mean that joint leakage may be neglected. In my opinion, it does indicate that if, after thorough overhauling of meters, the percentage unaccounted for exceeds 15, there are probably main pipe losses which can and should be eliminated. If the total losses from leakage and under-registration of meters can be reduced to 5 or 6 per cent. we shall have made a long step in conservation, and one worth the expenditure of considerable sums of money.

MR. D. A. HEFFERNAN.* Milton's experiences in this line may be interesting to some. We have over fifty miles of mains, all cast iron, bell and spigot leaded joint, and about forty miles of services, brass, cast iron, cement-lined, enameled, galvanized, lead, plain iron, tarred iron, and tin-lined lead, averaging in length 109 ft.

In replying to the questions distributed by the committee, I answered the one asking for an estimate of the amount of leakage in our systems that it was practically nothing. And although we have not made an exhaustive test of tightness in the past five years, I reasoned this way.

Milton has been very successful in accounting for its water. In 1915, 85 per cent. of its water was accounted for by registration of meters. Four causes for the loss of unconsumed water may be accounted for in towns 100 per cent. metered, as is the case in Milton:

1. Slippage or under-registry of meters.
2. Use of water at fires and in blowing off.
3. Use of water in puddling.
4. Leakage.

Meters have been perfected in late years so much that slippage has become practically nothing. The under-registry is a point

* Superintendent of Water Works, Milton, Mass.

that amounts to considerable in municipalities that have been metering their systems for any number of years. When a meter has been in continuous service for fifteen or twenty years, it will be found upon testing that the consumer has been benefiting to the extent of from 10 per cent. to 30 per cent., varying with the type and size of meter. The remedy is to have a plan of removing and making repairs on a certain proportion of meters each year so that meters in service over five years will be the exception, not the rule.

A town with any number of dead ends can account for more of its water. Milton has upward of 100. These necessitate frequent blowing-off, each operation averaging fifteen or twenty minutes. Use of water at fires brings up another large factor. Of course, these last two points are necessary evils, one of which may, as time goes on, be diminished. I refer to the dead-end evil. A growing community must countenance the lack of complete circuits including the entire system. They can be put in connection gradually only in accord with steady growth in one district. But until these are completely conquered, comparatively tight systems will be looked on as embracing approximate perfection. Fires, of course, will always be, and unless each hydrant is metered, water thus used must be estimated, not accurately computed.

We come to water used in puddling the backfill. It is understood that we find an excuse for a rather small proportion under this heading. It is but another small outlet which helps make the total large.

Milton has, on the whole, a rather small percentage left for which leaks may be accused. This is borne out by figures of the night flow. In 1912, Milton used between 1 and 4 A.M. 12 gal. daily per capita. The next year the flow decreased to 10, which it has steadily maintained since, the lowest in the Metropolitan district.

Both service and main work is tested under working pressure before backfilling. Installing gates at frequent intervals to accomplish this is avoided by means of a testing plug used on 2-in. work and over. Milton does all its work, and, therefore, is in a position to know that all construction is done under the best possible conditions and that nothing is skimped.

It has been my experience while connected with the Milton Water Department that the great majority of leaks are from causes foreign to the water system. Almost 95 per cent. of the main leaks may be attributed to cross trenches settling and carrying the water pipe down. In many service leaks I blame the leak on the condition of the soil; for example, ashes eat quickly into lead pipe.

On the whole, I do not consider that anything is radically wrong with our present method of pipe laying, but if it is possible to approach nearer to the unattainable absolutely tight system, I am with you.

COMMITTEE ON METER RATES. REPORT ON WASTE; TO WHICH IS ADDED SUGGESTIONS FOR SERVICE CHARGES FOR LARGE METERS.

[*Presented November 6, 1916.*]

Your Committee on Meter Rates presented a preliminary report on September 9, 1914, and a final report on February 9, 1916, on the subject originally referred to it. At the March, 1915, meeting, after the presentation of the preliminary report, your committee was instructed to investigate and report upon "the water unaccounted for or lost in leakage," because "that question also is involved in meter rates and it would be desirable to secure more exact information upon it."

Pursuant to this instruction, your committee has collected statistics as to the use and loss of water, and other allied matters, from a number of completely metered systems, and it now presents these statistics, with some comments thereon. These records show the normal distribution of business among large and small consumers and among large and small meters.

With the aid of this information, the committee now makes a suggestion with reference to service charges for meters from $\frac{3}{4}$ to 6 in. in size. In the preliminary report such a suggestion was made for an appropriate service charge for a $\frac{5}{8}$-in. meter. Data at the committee's disposal at that time did not warrant extending the suggestion to larger meters. With the aid of the information now available, the committee now adds this study (which it considers suggestive rather than final and definite) to the Association for consideration.

Water Unaccounted For.

Upon being instructed to investigate water unaccounted for, the committee was somewhat in doubt as to what investigation it could wisely make. A number of methods of approaching the problem were discussed. Some of these involved experimental

work that the committee did not feel that it could carry out. It was then decided to make an inquiry for statistics of members of this Association and others having in their charge completely metered water-works systems. Systems having more than 90 per cent. of all their services metered (those remaining unmetered being limited ordinarily to single-faucet houses) were considered as completely metered. As it turned out, however, the number of unmetered services in the systems for which statistics were obtained was less than one per cent. of the whole number. It was thought by the committee that statistics for systems less completely metered would be of little use in this connection.

In the circular letter which was issued, information was asked as to the quantities of water supplied, sold by meter, otherwise accurately measured or estimated, and as to the quantities of water which could not be accounted for. The opportunity was also taken to get information as to a number of allied matters. In regard to a few of these matters, the information was so incomplete that nothing was done with it, but in other directions very gratifying returns were received and the statistics resulting from them should be of considerable assistance.

Returns were received from thirty-five systems that were completely metered or very nearly so. Sixteen systems were in New England. The others were well scattered over the United States, and one was in Canada.

These statistics were furnished by officers of water works of whom nineteen were members and sixteen were not members of the Association. They were given in some cases in great detail and represented a large amount of patient labor. The thanks of the committee is due to those who took so much trouble in their behalf, and especially to those who were not members of the Association.

These statistics have been summarized and are briefly set forth in the following condensed table. They are given in more detail in a larger table which accompanies this report, and which shows the most important data for each plant. Reference is made to this large table for all further details. (See Plate XV.)

NEW ENGLAND WATER WORKS ASSOCIATI
COMMITTEE ON METER RATES
ALLEN HAZEN, CHAIRMAN

DATA ON METERS, ETC.
September 22, 1916

Serial Number	Place.	Number of Services	Period Covered: No. of Months	Period Covered: Last Month	Average Daily Output: Average Daily Quantity Gallons	Average Daily Output: Gallons per Service Gallons per Unit	Average Daily Output: Per Measured	Average Daily Output: Allowed	Sales Gallons Daily: Recorded by Meters	Sales Gallons Daily: Otherwise Accurately Estimated	Sales Gallons Daily: Per Meter	Sales Gallons Daily: Per Unit	Not Accounted for Gallons Daily: Total	Not Accounted for Gallons Daily: Per Cent Output	Not Accounted for Gallons Daily: Gallons per Service Gallons per Unit	Not Accounted for Gallons Daily: Per Meter	Not Accounted for Gallons Daily: Per Unit	Meters: Total Number	Meters: Per Cent: 3/4" and Over	Meters: Per Cent: 1" and Over	Meters: Per Cent: 2" and Over	Meters: Per Cent: 4" and Over	Meters: Average Size of Meter Units	Number Class Average Q	Per Cent: 82	Per Cent: 246	Per Cent: 820	Per Cent: Gallo
1	Cleveland	34 881	12	8/15	78 230 000	825	573	P*	61 590 000	5 120 000	648	450	11 520 000	14.7	122	85		35 067	57.5	4.10	1.01	0.28	1.44		7.8	38.70	10.8	
2	Peoples Water Co	61 325	12	12/15	16 080 000	262	234	V	12 750 000	—	208	186	3 280 000	20.4	53	48		61 325	22.5	1.06	0.08	0.01	1.12					
3	New Orleans	51 093	12	12/15	25 100 000	490	309	V	15 300 000	—	311	195	9 200 000	36.7	180	113		51 093	10.30	3.39	0.90	0.60	1.59					
4	Seattle	41 831	12	12/15	30 700 000	718	354	Ent	22 900 000	—	548	280	7 100 000	23.6	177	87		40 181	65.6	6.53	2.56	0.52	2.03		43.50	29.00	9.05	
5	Providence	31 500	12	12/15	17 195 000	545	363	V	No Rec.									29 200	14.70	5.38	1.56	0.67	1.59					
6	Atlanta	29 733	12	12/15	16 998 800	572	465	P	12 300 000	2 550 000	416	337	2 140 000	12.6	72	59		29 733	3.19	2.30	0.88	0.17	1.29					
7	Winnipeg	29 287	12	12/15	8 500 000	290	240	V	No Rec.									29 287	8.12	4.00	0.64	0.05	1.21					
8	Syracuse	26 870	12	9/15	19 500 000	725	530	Pit	10 750 000	30 000	401	293	8 720 000	44.7	325	237		26 870	5.25	2.83	1.44	0.36	1.37					
9	Hartford	14 482	12	7/16	9 500 000	655	326	V	No Rec.									14 482	57.00	6.50	2.34	0.51	2.01					
10	New Bedford	14 138	12	12/15	7 650 000	541	347	Weir	6 580 000	70 000	462	296	1 040 000	13.6	74	47		14 138	23.10	4.05	1.58	0.50	1.56					
11	Springfield, Mass	13 529	12	11/15	10 600 000	781	362	V	7 950 000	—	577	268	2 650 000	25.0	192	89		13 751	38.01	10.46	2.36	0.89	2.16	—	83.00*	15.00*		
12	Houston, Tex	11 652	12	11/15	4 880 000	418	250	P	2 830 000	—	241	162	2 050 000	42.2	176	118		11 652	36.80	7.12	0.98	0.12	1.49					
13	Springfield, Penna	11 510	12	12/15	5 183 000	444	327	V&P	3 587 000	263 800	304	223	1 333 000	25.3	116	85		11 614	30.80	2.59	1.16	0.03	1.36					
14	Yonkers	9 842	12	12/15	8 310 000	347	580	V	5 560 000	1 470 000	565	390	1 200 000	15.4	130	90		9 847	7.40	4.00	1.74	0.37	1.45					
15	Brockton	9 418	12	9/15	2 830 000	300	240	P	2 140 000	—	227	161	690 000	24.8	73	59		9 418	5.15	2.70	0.83	0.13	1.25					
16	Malden	8 052	12	12/15	2 243 000	279	291		1 410 000	—	173	156	833 000	37.0	103	93		9 183	1.78	—	—	—	1.11	57.70	10.90	1.38	0.1
17	Oak Park, Ill.	6 998	12	12/15	2 060 000	295	238	V	1 700 000	80 000	243	210	300 000	14.6	43	37		6 998	4.04	2.43	0.58	0.10	1.16	96.30	3.46	2.27	0.2
18	New Rochelle, NY	6 676	12	9/15	3 500 000	524	406	V	1 878 000	—	281	218	1 622 000	46.4	243	187		6 676	10.10	2.90	1.30	0.32	1.29					
19	Poughkeepsie	5 147	12	12/15	2 410 000	467	378	V	1 431 000	220 000	278	224	759 000	31.5	147	118		5 157	6.05	3.47	1.09	0.10	1.24	68.30	18.7	3.35	0.1
20	New Britain	5 097	12	12/15	No Rec.				3 390 000	820 000	685	332						5097	32.06	6.70	2.15	0.93	2.00					
21	Fitchburgh	4 852	3	9/16					2 650 000	890 000	534	361						4 952	5.23	3.90	2.36	0.32	1.48	57.70	18.80	4.96	1.9
22	Chelsea	4 748	3	9/16	3 060 000	645	529	V	2 210 000	—	465	375	850 000	27.7	179	144		4 748	4.97	2.46	1.16	0.19	1.24	75.90	16.90	5.85	1.3
23	Gloversville	4 103	12	12/15	No Rec.				1 250 000	250 000	305	247						4 103	2.24	1.36	0.80	0.09	1.14					
24	Monmouth Water Co	3 991	12	12/15	738 000	185	145	P	527 000		132	111	211 000	28.6	53	45		3 991	2.91	1.80	1.15	0.13	1.19					
25	Woonsocket	3 905	12	9/15	1 820 000	466	280	P	1 490 000	20 000	382	229	310 000	17.0	79	47		3 905	5.10	3.98	1.76	0.74	1.67					
26	Western N Y Water Co	3 843	3	9/16	6 500 000	1690	765	V	5 020 000	—	1300	590	1 480 000	22.7	385	176		3 850	12.52	3.64	2.36	1.19	2.21	48.10	15.60	4.55	1.9
27	Meridian, Miss	3 321	1	9/16	2 850 000	725	595	P	1 560 000	710 000	432	354	580 000	20.3	150	131		3 621	3.35	2.90	0.97	0.19	1.32	60.00	17.00	4.50*	1.2
28	Winthrop, Mass	2 785	12	12/15	698 000	250	209	V	506 000	2 000	209	163	130 000	18.6	47	37		2 783	24.00	1.19	0.29	0.07	1.25	70.00	19.00*	1.70*	0.2
29	Miami, Fla.	2 497	12	12/15	1 220 000	489	424	P	624 000	—	250	206	596 000	48.9	239	198		2 497	2.84	1.88	0.76	0.20	1.21	60.00	18.00*	3.32	0.9
30	Milton, Mass	2 002	12	12/15	340 000	170	92	V	289 000	0	144	78	51 000	15.0	26	14		2 002	18.20	9.48	5.55	0.30	1.84					
31	Wellesley, Mass	1 559	12	12/15	470 000	303	249	V	267 000	2 000	172	141	201 000	42.8	130	106		1 530	4.41	4.15	1.62	0	1.22					
32	Belmont, "	1 328	6	6/16	409 000	308		V	316 000	—	238	—	64 000	21.0	63	—		1 328	—	—	—	—	—			2.87		
33	Middleboro "	1 127	12	12/15	330 000	293	262	—	199 000		177	156	131 000	39.7	116	104		1 127	4.15	2.30	0.44	0	1.12					
34	Duxbury "	281	12	9/15	46 930	167	185	P	30 170	302	107	106	16 458	36.1	59	58		281	0.71	0	0	0	1.01					
35	Addison, N.J.	256	3	7/16	18 900	75	74	V	16 000		63	62	2 900	15.3	11	11		256	1.18	0.39	0	0	1.01	18.00	2.30	0	0
	Totals	574 364			283 182 830	1/yr 46 950			191 590 170	12 467 308	11472	7642	80 358	7.81	3713	2623		570 719	455.72	121.48	45.39	7.62	40.47	733.80	296.66	68.70	20.3
	Number of Times					32	31				32	31		29	29	28			34	32	32	32	34	12	13	10	13
	Average.					498	381				358	245		2.76	130	94			13.40	3.89	1.42	0.30	1.19	61.15	22.82	4.91	1.56

* Part of water measured by Venturi meter.

* Interpolated from Plotting

CIATION
5
C.

Number of Consumers Classified by Average Quantities Taken.							Sales Classified by Average Quantities Taken.							Normal Maximum Deliveries of Meters of Several Sizes, Obtained Approximately by Graphical Methods.						
Per Cent of Total Number							Per cent of Total Sales							Gallons. Daily.						
Over							Over													
246	820	2460	8200	24600	82000	246000	82	246	820	2460	8200	24600	82000	246000	5/8"	3/4"	1"	1 1/2"	2"	3"	4"
Gallons daily							Gallons daily.													
.70	10.0	3.20	1.00				97.80	88.90	7.00	6.08	3.50*				1370	1920	2800				
.00	9.05	3.95	0.78	0.407	0.061	0.002									—	1300	2950	3800	7400	18000	37000
			0.45	0.105	0.022	0.009															
.50*	1.50*	5.00*	1.10*	0.14*	0.018*	0.002*									300	1150	3000	4400	7000		
			0.068	0.043	0.011	0					14.10	13.00	6.79	0							
.8	1.38	0.38	0.126	0.025	0.012	0	99.17	57.66	31.57	29.51	18.74	10.68	7.19	0	740		1350		10700		
.6	2.27	0.229	0.129	0.059	0	0	99.17	57.49	23.11	18.03	15.77	11.67	0	0	600	800	1250	1600	9200	11000	26000
					0.030	0															
	3.35*	0.85*	0.27	0	0	0									580	820	1400	2100	6300	27000	
.1	4.86	1.90	1.09	0.371	0.082	0	96.52	86.09	75.57	68.26	62.09	45.43	21.30	0	780	1100	1450	2000	3000	5100	40000
.0	5.85	1.31	0.442	0.147	0.082	0	96.66	85.23	49.80	37.69	29.68	21.46	12.13	0	980	1550	2300	2900	13000	19000	52000
					0.077	0.028							5.20	1.90							
	4.55	1.82	1.27	0.73	0.360	0.150	98.37	94.84	91.36	88.57	86.65	73.92	64.15	42.26	300	1000	1850	—	4800	10000	16000
	4.50*	1.25*	0.38	0.185	0.078	0.052							39.50	46.60	1050	1750	2500	3000	10000	13000	
	1.70*	0.27*	0.08	0	0	0	83.00*	50.00	16.00*	7.50*	4.50*	0	0	0	220	1000	1300	2300	6000		
	3.32	0.90	0.20	0	0	0	95.00	70.00	47.14	33.00	22.49	0	0	0	960	1300	2400	2800	7000	8200	
	2.87		0.075						31.30		11.80										
	0	0	0	0	0	0	67.09	15.50	0	0	0	0	0	0							
68.70	20.56	7.574	2.130	0.773	0.250	0.054	89.269	79.431	44.625	33.758	30.821	17.196	18.16	9.076	7750	13230	26600	34700	93400	111300	207000
14	13	16	14	16	15	11	9	9	10	9	11	9	11	11	11	11	12	9	11	8	5
4.91	1.585	0.461	0.152	0.048	0.017	0.005	83.19	64.08	44.67	37.51	27.35	19.11	16.20	8.25	705	1203	2050	2744	7552	12912	40200

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CONDENSED SUMMARY OF STATISTICS ON USE AND LOSS OF WATER.

(Averaged by Systems.)

		No. of Systems Represented in Calculation of This Item.
Total number of services	524 364	35
Total number of meters	520 719	35
Average daily output, gallons	289 182 000	33
Recorded by meters, gallons	191 590 000	33
Otherwise accurately estimated, gallons	12 467 000	17
Not accounted for, gallons	59 180 000	29
Per cent. not accounted for	27.0	29
Per cent. of meters ¾ in. and over in size	13.40	34
Per cent. of meters 1 in. and over in size	3.80	32
Per cent. of meters 2 in. and over in size	1.42	32
Per cent. of meters 4 in. and over in size	0.30	32
Average size of all meters in terms of one ⅝-in. meter	1.43	34

Maximum Normal Output of One Meter.	Gal. Daily.	Cu. Ft. per Quarter.	
⅝ in.	705	8 600	11
¾ in.	1 200	15 000	11
1 in.	2 050	25 000	12
1½ in.	2 740	33 500	9
2 in.	7 580	92 000	11
3 in.	13 900	170 000	8
4 in.	40 200	490 000	5

	Per Cent. of All Takers.	Per Cent. of All Water Sold.	
Using over 82 gal. daily	61.14	89.19	12 & 9
Using over 246 gal. daily	22.82	66.08	13 & 9
Using over 820 gal. daily	4.91	44.67	14 & 10
Using over 2 460 gal. daily	1.60	37.51	13 & 9
Using over 8 200 gal. daily	0.46	27.35	16 & 11
Using over 24 600 gal. daily	0.15	19.77	14 & 9
Using over 82 000 gal. daily	0.05	16.20	16 & 11
Using over 246 000 gal. daily	0.02	8.25	15 & 11

	Per Meter.	Per ¾-in. Meter Equivalent.	
Total output, gallons daily	492	341	32 & 31
Total sales, gallons daily	359	245	32 & 31
Not accounted for, gallons daily	130	94	29 & 28

The full table showing the detailed results here summarized is appended.

These systems had 524 364 services and 520 719 meters. The daily output, estimating roughly for three systems where sales are reported but not the total output, is about 300 million gallons, or 575 gal. per service. Of this quantity about 140 gal. per service is not accounted for.

The committee is impressed with the fact that the number of completely metered systems has greatly increased in the last few years. Apparently, also, the percentage of the total output that can be accounted for in completely metered systems has increased. Fifteen or twenty years ago an American water-works system that accounted for 60 per cent. of the total output was doing well, although in Europe, where the meter system had been earlier used and more completely developed, as much as 90 per cent. of the output had been often accounted for. The statistics now collected indicate that on an average 73 per cent. of the total output is now accounted for.

Averaging by Systems.

In general, the average for each system has been obtained, and then these averages for all systems reporting that item have been averaged.

This procedure gives the data for small systems as much weight as those for large ones. As the conditions of the business in small systems vary somewhat from those in large ones, the method tends to produce a result which better represents the smaller systems than the larger ones. The committee feels it necessary to point out this difference, although it believes that the results obtained in this way may be more generally useful than those that might be obtained by another system of averaging. For some of the items an average made up from the total figures is also given.

Many of the Reports Partial.

Only a few of the reports were filled out with reference to each item. A complete answer to the committee's questions required a reclassification of accounts, and this involved an amount of labor and perhaps also an additional expense that some of those

who replied felt could not be undertaken. This was stated to the committee in several cases, and it was, no doubt, the principal reason why returns were not received from a number of completely metered systems for which requests were made.

In making up the statistics, the returns for each item are used for every system for which they are available. The different items are, therefore, made up from data from different systems. *Because of this condition, there are apparent discrepancies in the averages. No effort will be made to harmonize these differences. The whole study is to be taken not as showing an exact average result, but rather as a compilation of representative figures that, without being precise, gives one a fair idea of some of the fundamental conditions of service as the water-works business is now carried on.*

Methods of Measuring Water.

A majority of the systems measure their total output by Venturi meters. Where pump measurement is used, there is evidence of a study of the question of slip in nearly all cases, and suitable allowances have been made. Pitometer measurements were depended upon in some cases, either directly or for checking up the pumps, and in one case the water was weired. In three gravity systems there is no record of the amount of water supplied.

Total Output.

In 32 systems reporting, the average daily output per service, averaged by systems, is 492 gal. per day. The difference between this figure and 575 gal. obtained from the gross quantities indicates the difference that may result from different methods of handling the same data, either of which considered by itself might be accepted as correct.

Total Sales.

The average amount of water sold in 32 systems amounted to 359 gal. per day per service. It is to be noted that three of the 32 systems are different ones from those used in computing total output, and the figures, therefore, are not directly comparable.

Amount of Water Not Accounted For.

The records from 29 systems, after allowing for all the water sold and measured or otherwise accurately estimated, show an amount not accounted for of 130 gal. per service daily. (This may be compared with 140 gal. obtained by considering the total quantities.)

The water not accounted for averaged 27.0 per cent. of the total output. For the several systems, water not accounted for ranges from 12 to 49 per cent. Nine systems, or nearly one third of the whole number, showed more than 80 per cent., and 4 systems, or one seventh of the whole number reporting, showed more than 85 per cent. of the water accounted for.

The amounts not accounted for per service vary from 11 gal. to 385 gal. daily. For 7 systems, or one fourth of the number reporting, the water not accounted for was less than 50 gal. per service, while for 2 systems less than 40 gal. per service is reported.

The committee considered the water not accounted for in still another way, namely, by taking in account the relative number of large meters in the different systems and proportioning the loss so that the large meters would take their share in proportion to their size. As the number of large meters in the different systems varies rather widely, this introduces another element of considerable importance into the calculation.

In carrying this out, certain ratios were assumed as representing the proportionate capacity of the larger meters. The figures used were as follows:

Size of Meter. Inches.	Relative. Capacity.
⅝	1
¾	1.67
1	3
1½	6
2	10
3	22
4	40
6	90
8	160
12	360

These ratios differ slightly for the larger sizes from those used

later for another purpose in this report. The differences do not warrant a recalculation of the data for the present use, and the results first reached are allowed to stand.

The average size of meters in each system was computed, using the numbers of meters of each size and these ratios. In this way it was found that the average size of all the meters in all the systems was 1.43; that is to say, the discharging capacity of all the meters is 43 per cent. greater than it would be if all the meters were $\frac{5}{8}$ in. in size. In different systems the excess ranged from 1 per cent. to 121 per cent.

Dividing the loss per service for each system by the average size of meters for that system gives the average loss per $\frac{5}{8}$-in. unit. Calculated in this way the water not accounted for amounts to 94 gal. daily for each unit, and for the several systems the range is from 11 to 174 gal. Of 28 systems, 8 show water not accounted for under 50 gal. per unit daily.

How the Water is Lost.

The water that is not accounted for is made up of various sources of loss. Included among these may be mentioned the following:

1. Leakage from the mains in the streets.
2. Leakage from the service pipes between the mains and the meters.
3. Under-registration of meters.
4. Water used for various purposes, not registered or estimated, as, for instance, water used for flushing sewers.

The committee has no means of distributing the total loss among the different sources of loss. It is the committee's belief that under-registration of meters forms a substantial part of the total loss in systems where the pipes and service pipes have been carefully and systematically followed up for leakage and where there have been no considerable uses of water for flushing sewers and similar uses without record being made of it.

As can be ascertained from the statistics which follow, meters on about half (48 per cent.) of the total number of services pass less than 100 gal. per day.

There are few meters in use at the present time that will register a steady flow of as little as 100 gal. per day.

If the amount of water now shown by that half of all meters which pass the smallest quantities of water were to pass at a uniform rate, it would all pass as leakage without moving the pistons or disks of the meters and would fail to be recorded.

It is recorded in part because that part which is recorded is drawn at higher rates, but wherever there is leakage in plumbing, so that the leak amounts to less than 100 gal. per day, more or less, according to the sensitiveness of the meter, the amount of water so lost by leakage will pass without being registered. The water that is registered probably is all drawn in, at most, one or two hours of total time, and during the remaining twenty-two or twenty-three hours of the day there will be no registration of whatever leakage there may be in the plumbing.

Some of the large-size meters will pass much larger quantities without registering.

Relative Number of Meters of Different Sizes.

On an average for all the systems, 86.6 per cent. of all the meters are of the $\frac{5}{8}$-in. size, but in a majority of systems 94 per cent. or more of all the meters are of this size. Meters 1 in. and over form 3.80 per cent. of the whole number, and those 2 in. and over are 1.42 per cent., while meters 4 in. in diameter and over are 0.30 per cent. of the total number. These are the figures averaged by systems.

The figures for the aggregate number of meters being unusually complete, it may be of interest to also record the total numbers and their distribution.

Size of Meter. Inches	Total Number of Meters in 33 Systems.	Percentage of Total Number.
$\frac{5}{8}$	432 231	84.546
$\frac{3}{4}$	57 406	11.229
1	11 378	2.225
$1\frac{1}{2}$	3 148	0.616
2	4 005	0.783
3	1 374	0.269
4	1 115	0.218
6	533	0.104
8	46	0.009
10 & 12	8	0.002
	511 240	100.000

In making up this table, a small number of $\frac{3}{8}$-in. and $\frac{1}{2}$-in. meters are included with the $\frac{5}{8}$-in. meters, and a very few $1\frac{1}{4}$-in. and other odd sizes are included with the next size smaller.

Classification of Service by the Amount of Water Drawn by Each.

This classification according to quantities of water involved a large amount of labor to those who reported to the committee, and the number of complete returns was smaller than for other items. Nevertheless the returns are sufficiently numerous to give a very good idea of the normal distribution of takers in the various classes.

In asking for this data, the committee followed the classification which it had suggested in its first report on meter rates, but carried it further by subdividing the different classes so as to show more completely the number of consumers taking different quantities of water.

In using the returns it will be convenient to refer to the quantities in gallons per service per day. All the figures in whatever unit reported have been reduced to this basis.

The lowest limit used in the classification was 82 gal. per service per day, which is equal to 1 000 cu. ft. per quarter.

It is found that (12 systems reporting) 38.86 per cent. of all the takers use less than 82 gal. per day. Almost the same number, namely, 38.32 per cent., use between 82 and 246 gal. per day. A further number, 17.91 per cent., use between 246 and 820 gal. per day, making a total of 95.09 per cent. using less than 820 gal. per day, or 10 000 cu. ft. per quarter. All these takers, ninety-five per cent. of the whole number, would come entirely under the domestic classification suggested in the committee's preliminary report.

Following the classification, 3.31 per cent. use between 820 and 2 460 gal. per day and 1.14 per cent. use between 2 460 and 8 200 gal. per day, making a total of 4.45 per cent. of all the takers that would come under the intermediate classification of the committee's preliminary report.

Of larger consumers coming under the manufacturing classification, 0.31 per cent. use from 8 200 to 24 600 gal. per day; 0.10

per cent. from 24 600 to 82 000 gal. per day; 0.83 per cent. from 82 000 to 246 000 gal. per day, and 0.02 per cent. over 246 000 gal. per day, making a total of 0.46 per cent. of the whole number of takers that would use enough water to get the manufacturing rate.

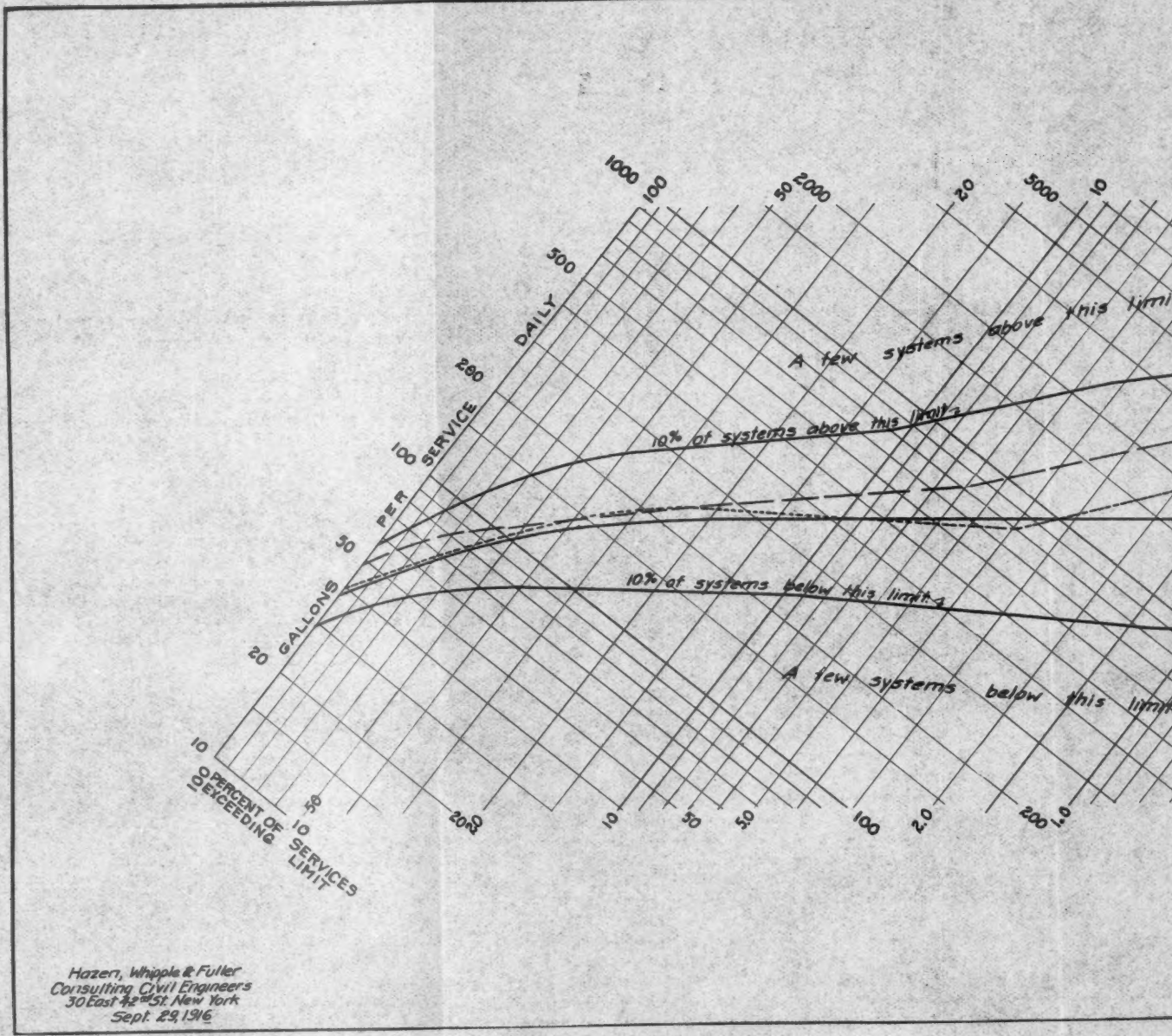
The data represented by the above brief statement have been otherwise arranged and are plotted on a diagram which is presented herewith (Plate XVI). This diagram shows the percentage of the total number of consumers taking more than various quantities of water daily, arranged in a number of different ways. A dotted line shows them averaged by the gross numbers in the systems for which the statistics were reasonably complete. A broken line shows them averaged by systems, which, as above noted, gives one small system the same relative weight in the averaging as one large one. Three other solid lines show the figures arranged in the order of size, the middle one being the medium, so selected that half the results fall below it and half above it, while the two lines marked as the normal 10 per cent. limit and the normal 90 per cent. limit are the lines which include 80 per cent. of all the results. Ten per cent. of the results fall outside of these limits on either side, representing, on the one hand, systems in which manufacturing and large users are unusually developed, and, on the other hand, small systems in which there are no such uses.

This diagram shows in compact space a more complete representation of the data than can be well given in a table.

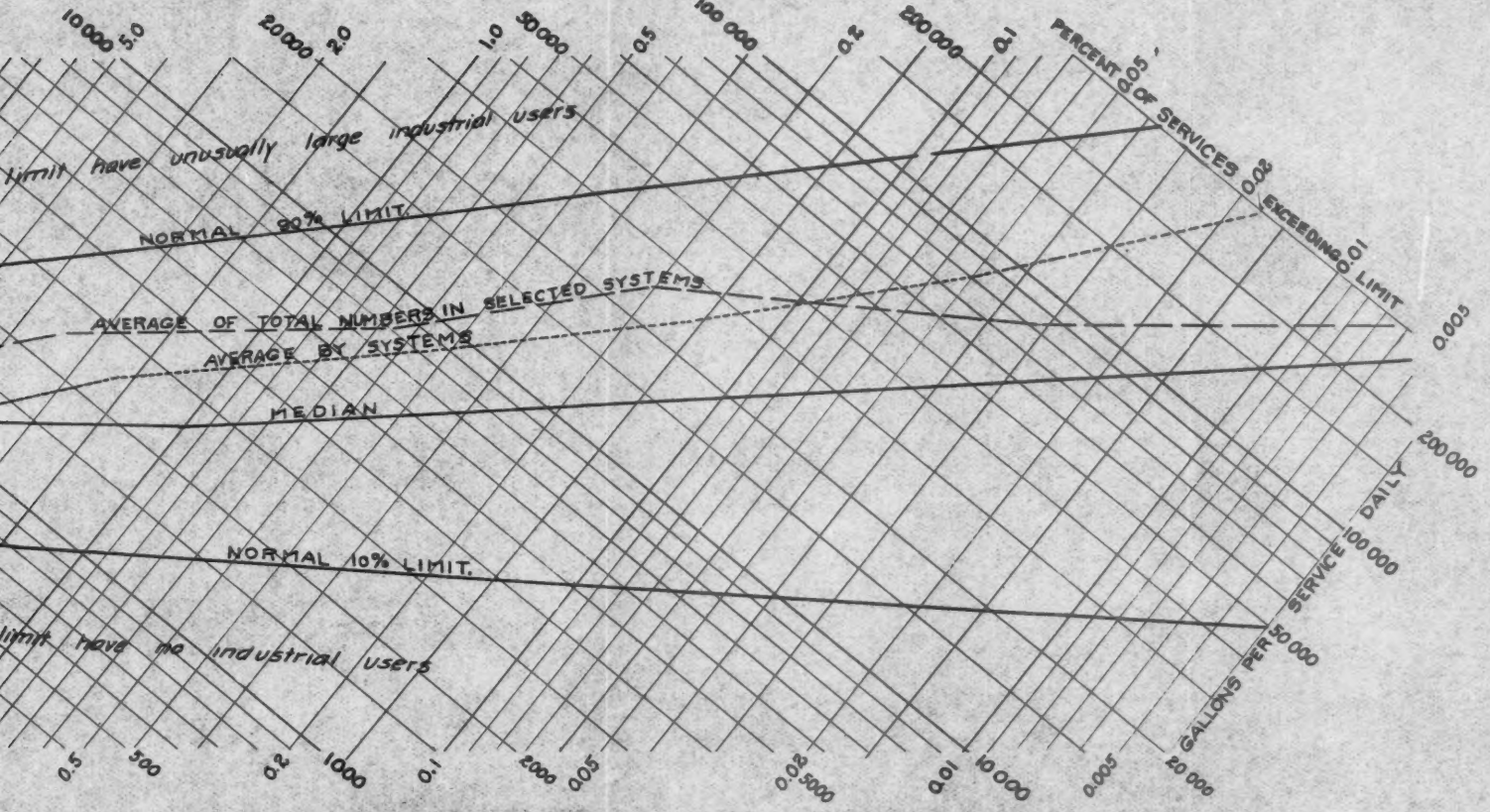
Amounts of Water Sold to the Above Classes.

Averaged by systems (9 to 11 systems reporting), 55.32 per cent. of all the water is sold to takers coming under the domestic rate; 17.32 per cent. is sold to customers coming under the intermediate rate, and 27.35 per cent. to customers coming under the manufacturing rate.

Averaged by aggregate numbers, the distribution is different, as the larger systems supply more water relatively for manufacturing purposes. The following table gives an approximate distribution indicated by the data arranged by the total numbers



Hazen, Whipple & Fuller
Consulting Civil Engineers
30 East 42nd St. New York
Sept. 29, 1916



NEW ENGLAND WATER WORKS ASSOCIATION
COMMITTEE ON METER RATES
ALLEN HAZEN, CHAIRMAN

DIAGRAM SHOWING CLASSIFICATION OF TAKERS
BY QUANTITIES OF WATER DRAWN

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in each class for those systems for which reasonably complete reports are available.

Range in Daily Quantities, Gal. Daily per Service.	Average Daily Quantities Sold per Service.	Per Cent. of Total Number of Services Coming in This Class.	Per Cent. of Total Output.	Total Output, Gal. per Day, from 100 Services.
0 to 82	51	29.420	3.41	1 500
82 to 246	146	47.865	15.91	7 000
246 to 820	385	16.755	14.63	6 440
820 to 2 460	1 300	3.594	10.59	4 660
2 460 to 8 200	4 070	1.807	16.64	7 320
8 200 to 24 600	12 700	0.356	10.27	4 520
24 600 to 82 000	42 300	0.071	16.37	7 200
82 000 to 246 000	120 000	0.024	6.52	2 870
Over 246 000	311 000	0.008	5.66	2 490
Total	440	100.000	100.00	44 000

These figures are made up by approximate methods, with a few doubtful returns excluded. They are believed to represent the distribution fairly well and they check the total very well, for they show 440 gal. per service on an average sold, and adding the 140 gal. per service not accounted, which is the average from the total number, makes 580 gal. per service. This checks approximately the 575 gal. found by direct division.

Quantity of Water Delivered by Meters of Various Sizes.

The statistics collected by the committee permitted an approximate study to be made of the amounts of water delivered by meters of various sizes. This study is made by graphical methods (plotting on logarithmic paper) and is approximate. It rests on the fundamental assumption that the largest meter in any system supplies that service in the system from which most water is drawn; and that all the other services are to be assigned to the meters of the several sizes in the order of their outputs. This is not strictly correct, but for practical purposes it may not be much in error, because there are bound to be as many larger meters coming under any given limit as there are smaller meters exceed-

ing it. There will be some variations both ways, but in the aggregate these will balance.

Examined in this way, it appears that the normal maximum output for one $\frac{5}{8}$-in. meter (data from 11 systems) is 705 gal. per day. In other words, averaged by systems there are as many $\frac{5}{8}$-in. meters as there are services from which less than 705 gal. per day are drawn. The average output from all the $\frac{5}{8}$-in. meters is considerably less than this. Averaged by systems, it seems to be about 116 gal. per day. The 705 gal. per day, or 8 600 cu. ft. per quarter, is the normal maximum limit for output of a meter of this size.

Different systems vary rather widely in the maximum limits for $\frac{5}{8}$-in. meters, quantities ranging from 220 to 1 370 gal. daily being found. This difference is to be attributed principally to the divergence in practice with reference to the use of $\frac{3}{4}$-in. meters on the larger domestic services.

The classification of quantities is not available for some of the systems using the largest proportion of $\frac{3}{4}$-in. meters, and, if these statistics were available and were included, it is probable that it would lower considerably the average limit for the $\frac{5}{8}$-in. meter probably to between 300 and 400 gal. daily. There is a similar but less marked variation at the line between the $1\frac{1}{2}$-in. and the 2-in. meters.

In a similar way, the average maximum outputs for other sizes of meters are as follows:

Size of Meter. Inches.	Normal Maximum Output. Gal. per Day	Corresponding Number of Cubic Feet per Quarter.
$\frac{5}{8}$	705	8 600
$\frac{3}{4}$	1 200	15 000
1	2 050	25 000
$1\frac{1}{2}$	2 740	33 500
2	7 580	93 000
3	13 900	170 000
4	40 200	490 000

The detailed figures show considerable divergence of practice with reference to the amounts of water that meters of all sizes will handle, but the divergence with respect to the line of division between $\frac{5}{8}$-in. and $\frac{3}{4}$-in. meters is much greater than else-

where, and the committee suggests that an interesting and profitable subject for discussion by the Association would be the question as to whether it is better to use a $\frac{5}{8}$-in. meter or a $\frac{3}{4}$-in. meter for services drawing from 300 to 1 000 gal. per day. Such a discussion would tend to establish the principles that should govern, and it might aid in reaching a more logical and scientific method of determining the size of meters required for various services.

It is, of course, true that services are occasionally found which require water at a certain rate, and where that rate determines the size of meter even though the total aggregate draft is small, but it would seem as though, generally speaking, some relation between the normal rate of draft and the size of meter in the larger domestic services might be found.

The distribution of the whole output among meters of different sizes, estimated by the aid of graphical and roughly approximate methods (subdividing as a matter of interest the $\frac{5}{8}$-in. meters into four divisions) is shown by the following table:

Size of Meter. Inches.	Per Cent. of Total Number of Services.	Mean Quantity per Meter. Gallons per Day.	Total Quantity 100 Services. Gallons Daily.	Per Cent. of Total Quantity of Water Sold.
$\frac{5}{8}$ a	25	50	1 250	2.84
$\frac{5}{8}$ b	25	90	2 250	5.11
$\frac{5}{8}$ c	25	150	3 750	8.52
$\frac{5}{8}$ d	9.546	275	2 620	5.91
Total $\frac{5}{8}$	84.546	116	9 870	22.38
$\frac{3}{4}$	11.228	580	6 500	14.82
1	2.225	1 700	3 780	8.59
$1\frac{1}{2}$	0.616	2 380	1 470	3.34
2	0.783	5 500	4 300	9.77
3	0.369	10 000	3 690	8.39
4	0.218	20 000	4 360	9.91
6	0.104	70 000	7 280	16.55
Larger	0.011	250 000	2 750	6.25
	100.	440	44 000	100.

In this connection, a table from the New Orleans annual reports for the years 1913 and 1914, George G. Earl, general superin-

tendent, shows the average daily drafts of water by meter sizes as follows:

Size of Meter. Inches.	Average Draft per Service. Gal. per Day. 1913.	1914.
⅝	148	162
¾	370	410
1	1 120	1 100
1½	2 400	3 100
2	6 100	6 500
3	.....	33 800
4	.....	8 350
6	.....	9 850
8	.....	45 700

This record is unique and most interesting. It is comparable with the average results deduced by the committee from the statistics furnished to it. The committee suggests that others might find it advantageous to follow this method of keeping track of sales classified by meter sizes. With books arranged for that purpose, it would not appear that the additional labor involved would be great.

Conclusions.

The committee concludes that with present American conditions, with a pipe system that has been carefully watched for leaks and made as tight as it is reasonably practical to make it, with complete metering and with meters carefully tested and kept in order in accordance with the best current practice, one may reasonably hope at the present time to reduce the unaccounted-for water to 20 per cent. of the total output, or to from 60 to 80 gal. per service daily. Some systems that are well managed fall short of these standards, and occasionally more favorable conditions may be reached and still lower figures obtained.

Better systems of testing old pipes in streets and service pipes between the street mains and the meters, a raising of the standard of efficiency of small meters at low rates of flow, the use of compound meters or other improved devices for making certain the registration of low flows through the larger meters, and estimating carefully by the best available means the amounts of water drawn for all uses where measurement by meter is not possible,

will all tend to increase the amount of water that can be accounted for.

Information as to the normal distribution of business between large and small takers and of the normal range of output for various meter sizes, made available by the statistics presented, should be helpful in discussing the question of meter rates and their classification and especially in fixing fair service charges for meters of the larger sizes.

Service Charges for Large Meters.

Considerable interest in this subject is indicated by the inquiries that have come to the committee in regard to it. It is the committee's view that the service charge for all meters, like the price per 1 000 gal. of water, should be left to local judgment and should be fixed in accordance with local conditions, and that the committee should make no invariable recommendation in regard to it.

The committee has already made, in its preliminary report, a suggestion with regard to the service charge for $\frac{5}{8}$-in. meters, and a like suggestion in regard to the service charges for larger meters coming from this committee may be helpful to many members.

The following study is made as to fair charges for larger meters.

Service charges for large meters should be based in a general way upon their carrying capacity. The carrying capacities of different meters of the same size vary greatly, and it is no easy matter to get a general basis that will be sufficiently accurate at all points. The committee considers in a general way that a 2-in. meter is equivalent in discharging capacity to ten $\frac{5}{8}$-in. meters, and it takes a 2-in. meter as the starting point for the discussion.

Comparison may be made on the basis of areas, that is, by the squares of the diameters. In the case of larger meters, this is nearly accurate. In the case of smaller ones, the diameters used to designate the meters are understood to be nominal and may differ somewhat from the exact figures. Nevertheless, the areas computed from these diameters do give something of an idea of the relative capacities.

The relative carrying capacities of disk meters at a fixed loss of head, as given in the American Civil Engineers' Pocketbook

page 967, may be used. It is, of course, understood that different makes of meters vary a good deal in their capacities. The figures mentioned were compiled by the chairman of this committee, some years ago, after receiving returns from various manufacturers of meters and examining records of experiments by a number of members of the Association, and they were selected as being representative of the different sizes. Round figures were used, and they are to be taken as a general indication only.

The maximum normal amount of water supplied by each size, as deduced by this committee from the returns made to it in the inquiry with reference to waste prevention, may also be used. The figures obtained in this way represent only a limited amount of data, but that is the best of its kind now available to the committee. There are some irregularities in the scale. For instance, 2-in. and 4-in. meters are distinctly more popular and are used in larger relative numbers than some of the intermediate sizes, and in fixing the normal capacity of meters the influence of the tendency must be discounted to reach the fair relative capacities.

The relative capacities of meters of several sizes calculated in each of these three ways, taking the capacity of a 2-in. meter as ten in each case, are as follows:

Size of Meter. Inches.	Ratio of Areas.	Ratio of Carrying Capacities of Disk Meters at Fixed Loss of Head.	Ratio of Maximum Normal Outputs Indicated by Committee's Statistics.	Ratio Used for This Discussion.
$\frac{5}{8}$	0.98	1.14	0.93	1.0
$\frac{3}{4}$	1.41	1.85	1.59	1.7
1	2.50	3.20	2.71	3
$1\frac{1}{2}$	5.62	6.25	3.60	6
2	10.00	10.00	10.00	10
3	22.50	20.80	18.40	20
4	40.00	35.00	53.00	30
6	90.00	62.50		60

Service Charges Deduced from These Ratios.

In the preliminary report of this committee, of September 9, 1914,* it was suggested " that the service charge for a $\frac{5}{8}$-in. meter would be made up of three parts, namely, —

* Journal N. E. W. W. A., XXVIII, 199.

"First, 10 per cent. of the average investment of the works in the service pipe and meter.

"Second, $1 per annum for reading meters, billing, and collecting.

"Third, $2 per annum for the probable value of unregistered water.

"For a domestic service charge with $\frac{5}{8}$-in. meter, the ordinary service charge may properly be $3 when the service and meter are paid for by the taker; $4 when the meter is furnished by the works; and $5 or $6 where both meter and service pipe are paid for by the works; the lower figure being used where the average cost of the service pipe is under $15 and the higher where it is greater than $15."

The item in this calculation for a large meter corresponding to the $2 per annum in the above schedule, "for the probable value of unregistered water," must also cover any cost to the system that there may be in the extension of mains and other facilities that will be necessary in connection with the use of large service connections, and any value that there may be to the taker in having large quantities of water available instantly for any purpose.

With reference to the amount of water under-registered by large meters, it is interesting to note that in the experiments made by F. C. Kimball, at Knoxville, presented to this Association on September 10, 1903,* that of nine 6-in. meters furnished by their makers for test, only three were able to register a flow of 4 500 gal. per day. In other words, in a majority of new 6-in. meters, 4 500 gal. per day would pass entirely without registration. At 10 cents per thousand gallons, such an amount of leakage continuously for a year amounts to $164; and if, on an average of 6-in. meters, the leakage amounts to one half this quantity, it amounts to $82 per annum.

The possibility of loss of this quantity of water, and in some cases of a much greater quantity, is not to be taken as the sole ground for the service charge. Nevertheless, the facts that such losses are possible; that such losses do exist in many or most services; that the works have to furnish the water that is so lost;

*JOURNAL N. E. W. W. A., XVII, p. 305

that water costs money, and that the value of the water lost must be made up in some way, are among the substantial elements that must be considered in arriving at an equitable service charge.

Following the matter further, the service charges for larger meters are reached as follows:

Size of Meter. Inches.	Relative Capacity.	$2 per Unit of Capacity.	Service Charge, being $2 per Unit of Capacity with $1 Added.	Round Figure to be Used.
⅝	$1	$2	$3	$3
¾	1.7	3.40	4.40	5
1	3	6	7	7
1½	6	12	13	12
2	10	20	21	20
3	20	40	41	40
4	30	60	61	60
6	60	120	121	120

It is interesting to see how much per thousand gallons the application of these service charges would amount to for quantities of water that may be taken as the normal outputs for meters of the different sizes.

Taking annual quantities and smoothing the figures a little, by taking into account both the actual performance as indicated by the committee's returns and the possible performance as indicated by the relative capacities of the meters, we have the following tabular statement:

Size of Meter. Inches.	Service Charge.	Greatest Normal Quantity per Annum, Thousands of Gallons.	Least Normal Quantity per Annum, Thousands of Gallons.	Service Charge in Cents per Thousand Gal. for Greatest Normal Quantity.	Service Charge in Cents per Thousand Gal. for Least Normal Quantity.
⅝	$3	300	0	1.00	—
¾	5	500	300	1.00	1.67
1	7	900	500	0.78	1.40
1½	12	1 800	900	0.67	1.33
2	20	3 000	1 800	0.67	1.11.
3	40	6 000	3 000	0.67	1.33
4	60	9 000	6 000	0.67	1.00
6	120	18 000	9 000	0.67	1.33

This indicates that, for the $\frac{5}{8}$-in. meter on the largest services normally handled by meters of this size, the service charge will amount to 1 cent per 1 000 gal. With one sixth of this amount passing, which perhaps approximately represents the average work of a $\frac{5}{8}$-in. meter, the service charge is equivalent to about 6 cents per 1 000 gal. The table shows the corresponding figures for all the sizes. For the larger meters the service charge ranges from $\frac{2}{3}$ of a cent per 1 000 gal. for meters working to the ordinary limit of their capacity, increasing to an average of about $1\frac{1}{3}$ cents per 1 000 gal. for meters passing the smallest normal quantity, which is taken as equal to the greatest normal quantity handled by a meter of the next smaller size. In other words, in a general way for manufacturing meters the service charges adjusted in this way would vary between $\frac{2}{3}$ of a cent and $1\frac{1}{3}$ cents and probably would average about 1 cent per 1 000 gal. for meters working at normal capacity.

In connection therewith, a manufacturing rate would naturally be selected about 1 cent per 1 000 gal. less than would be used if these service charges were not to be collected.

With this procedure followed, the water works could always let the taker select the size of meter. If the taker selected a large one, the works would be insured of a return for it commensurate with its cost and with the probable general cost of supplying the extra mains and connections required in connection therewith and of standing the extra losses of water by leakage and under-registration that also must be anticipated. In other words, the water-works plant would have no objection to the installation of large meters in any number if the takers were willing to pay for them. This the committee believes is a logical condition for the best interests of the business. It can only be secured by the use of an adequate service charge.

If any taker has a meter which is worked to the limit of its capacity, that is to say, one that is supplying more than the ordinary maximum assumed for that size of meter, the effect would be that such a taker would get automatically a small discount on his bill, because the service charge for that meter would be applied to the larger quantity of water drawn through it. On the other hand, if a meter considerably larger than needed,

or than is usual for the quantity drawn, were used, the service charge would amount to more per 1 000 gal. than the normal amount and the taker would be paying something extra for the extra capacity required and furnished to him by the works.

The use of such service charges would tend to discourage the use of unnecessarily large service connections and meters, and this is a desirable condition. On the other hand, with a one cent reduction in the manufacturing rates, there is no increase in bills in case of a normally busy meter.

The committee suggests further that the service charge always be reckoned on the size of meter and not on the size of service pipe, thus giving an opportunity to one who has put in a meter that is too large to substitute a smaller one and get the benefit of the smaller service charge without having to change his service pipe. This arrangement also permits the use of a larger service pipe than is needed to anticipate reduction of carrying capacity by corrosion through a long term of years, without requiring the use of an unnecessarily large meter, with payment therefor.

The figures above mentioned in no case include 10 per cent. of the cost of the service and meter as far as paid for by the works and included by the committee as part of the service charge on $\frac{5}{8}$-in. meters, and this allowance should be added wherever the customer does not pay the first cost of the service and meter.

Conclusion.

Your committee, after considering the further discussions by members of the Association, renews its recommendation that the Association adopt the form of meter rate schedule presented to it by your committee, and printed on page 361 of the Journal of this year, as a standard form of rate for gradual adoption as meter rates are revised and when new rates are to be made.

This schedule is drawn in terms so broad that it covers both the uniform rate for all quantities as now used by a few systems and the sliding scale which is in much more general use.

Its principal advantage is that it simplifies and standardizes the sliding scale and also the question of whether a minimum rate or a service charge shall be used and the question of how the

amount shall be determined and applied, but it does this in a way that permits the uniform rate to be used where it is preferred.

The committee believes that this form of schedule provides all needed flexibility for present water-works conditions and that it will do away with many unjust discriminations contained in existing schedules of meter rates, and that its adoption will facilitate comparison between rates in different systems.

The committee believes that it has now completed all the work that it has been asked to undertake, and it requests that it be discharged.

Respectfully,

ALLEN HAZEN, *Chairman*,
A. W. CUDDEBACK,
A. E. BLACKMER,
JAMES L. TIGHE,
CHARLES R. BETTES,
PHILANDER BETTS,
Committee on Meter Rates.

DISCUSSION.

MR. ALLEN HAZEN.* Perhaps I may say a few words in regard to this schedule,† the adoption of which is recommended by your committee. The discussions that have taken place show that there has been some misunderstanding in regard to what it proposes, although I think a reading of the preliminary report and the final report would clear these up.

This proposed schedule does not fix meter rates. It simply fixes a form and leaves the rates to be written in, larger or smaller as local conditions require. The form of the schedule permits the sliding scale, but does not require it. It is broad enough to cover either a uniform rate or the sliding scale. At the present time I suppose nine tenths of all the water-works systems in the country use the sliding scale; but the sliding scale as now used is tremendously varying. There are almost as many forms of it as there are water-works systems. The committee believed that one simple standard form would answer just as well and a great

* Of Hazen, Whipple and Fuller, New York.
† XXX, 361. Presented February 9, 1916.

deal better than these endless variations, and the form suggested is the one which the committee believes will be most generally serviceable.

Adopting this form of schedule, then, means standardizing the sliding scale and standardizing it in such a way that one who prefers the uniform rate can use it.

And in connection therewith the committee has made recommendations in regard to service charges, although the amounts of the service charges that have been suggested by the committee are not part of the form of schedule that is recommended for adoption. The committee thinks that these amounts should not be adopted, but, like meter rates, should be left open for discussion in individual cases. The committee hopes its suggestions will be helpful, but it does not want to make them binding on any one.

Now, a good deal of the discussion of the committee's report related to the relative merits of the uniform rate and the sliding scale. That was a matter which the committee did not report upon. The form of rate schedule proposed by the committee is broad enough to cover both kinds of rates. There are many members of the Association who believe that the uniform rate is the logical form for use, and they may be right. I was disposed myself some time ago to think that a uniform rate in connection with adequate service charges would be fairest, but further study of the question has shaken my confidence in that earlier conclusion.

The whole cost of supplying water may be divided into three parts. There are various ways of classifying it, but I suggest for your attention this division. The annual cost may be most conveniently considered.

First, the cost of supplying water, including all the costs that there are up to the point when the water is delivered under pressure at a reasonably central point. This includes interest (or a proportional part of the net profits) on the whole investment or worth of the supply works and of the land held for use in connection with the supply; the depreciation on those works; all operating expenses, and a pro-rata division of general expenses of all kinds that cannot otherwise be assigned to a part of the service.

Second, the cost of distribution, including all the costs that there are for pipes in the streets and distributing reservoirs, and

the care of the pipes and the work that is done to prevent and stop leakage, and the value of whatever water may be lost as leakage from the pipes in the streets.

Third, the service cost, including the costs of service pipes and meters as far as they are borne by the water-works department, and all the costs of reading meters, billing, collecting, and general office expenses, and the value of whatever water may be lost as leakage or as under-registration of meters.

The whole annual cost of supplying water may be divided into these three parts, and the division may be made complete by dividing, pro-rata, taxes, salaries of general officers, etc., so that every cent of the gross income is assigned to one of the three parts.

Now, then, the cost of the water per thousand gallons is the cost of water under the first heading divided by the total annual output, and this cost is the first part of the meter rate. That ought absolutely to go with every gallon of water that is supplied, and it ought to be uniform to every one, whether a person takes one gallon or a million.

To drop for a moment our logical order, the service costs in the third heading can best be assessed on the takers as service charges. They can be and often are carried in other ways; that is to say, they can be loaded as a price per thousand gallons on the water sold, but the simplest and fairest way is to have all the service costs assessed on the services in proportion to their sizes, and that is what the committee thinks should be done.

We have left for disposal the distribution cost under the second heading. A part of the distribution cost is the fire service cost. Most of the fire service cost is included in the distribution cost. Most water-works systems receive some revenue for fire protection; most of them receive very much less for fire protection than the fire protection is really worth. The difference — that is, the excess in fair value over actual collections — has to be carried by the water rates. This unpaid part of the cost of fire service has to be paid by the water-takers in some form. They also must bear all the other costs of distribution. When actual receipts for fire service are taken out, all the rest of the cost of distribution of the water has to be carried by the water rates in some way. The money must be raised. Now, how is it going to be done?

Some people have thought that the distribution cost should be added to the service charge. There is a good deal to be said in favor of that view. That view has been reflected in the Wisconsin Commission's decisions, and in the writings of some people who have studied the matter closely. As far as the larger services are concerned, I think, perhaps, that is as good a way as could be adopted. But the rub comes with the $\frac{5}{8}$-in. meters. Ninety per cent., more or less, of all services are through $\frac{5}{8}$-in. meters, and a service charge adjusted to the size of the meter is absolutely uniform for 90 per cent. of all the takers. Now, the 90 per cent. of the takers who use $\frac{5}{8}$-in. meters do not represent by any means uniform conditions; they represent quite the reverse. There is the greatest diversity of conditions among those consumers. And if the whole of the load of the distribution cost is added to the service charges on meters, and all $\frac{5}{8}$-in. meters carry the same load, it means that the smallest takers, the smallest houses, are assessed to a point that it isn't wise to attempt to assess them and to a point that the business won't stand. As a practical proposition, gentlemen, you can't do it. The service charge cannot be loaded in that way, and the reason for it is that 90 per cent. of your services are through the same size of meters. There isn't any reason for splitting up this 90 per cent. of the meters into different sizes, and the committee does not know of any ready way by which those services can be classified and different service charges applied to some of them from those that are used for others. So loading the whole distribution cost on the service charges practically cannot be done.

Now, another way is to load it all on the price of the water. If we divide the whole cost of distribution by the whole quantity of water that is sold, we have the average total unit cost of distribution that can be added to the cost of the water. That can be done. That results in the uniform rate, and if it is desired, that is all right. But looking at it as a matter of cost to the works, the average industrial service, as the committee finds from these statistics, takes 30 000 gal. of water per day. The average domestic service takes just over 100 gal. per day. Anybody knows that it costs more per 1 000 gal. to handle two or three hundred domestic services with two for three miles additional street pipe than it

does to serve one manufacturing establishment. From the standpoint of cost of service, from the standpoint of ordinary business methods, an industrial service, taking an average of 30 000 gal. per day, naturally would get, and under American practice in nine cases out of ten does get, a lower rate per 1 000 gal. than a domestic consumer taking only 100 gal. per day. It is cheaper relatively to maintain the service of the large taker, and all the conditions of business, and nearly all the precedents, are in favor of that arrangement. If the uniform rate is adopted, the manufacturer is loaded to pay for the deficiency in revenue on the small services. That can be done. No system of water rates will distribute the load just where it ought to go, and it may be that the inequalities that grow out of the uniform rate are not so great that they cannot be tolerated.

But the other point of view is that, because of the well-known greater cost of service in supplying the small customers, this load is not to be distributed on all the water evenly, but instead it is to be distributed unevenly, putting some of it on all of the water and more of it on the water drawn by smaller services and on those that are intermediate in size.

That, gentlemen, results in the sliding scale. Perhaps it does not all work out in a way that you will think is ideal; there may be objections to it, but I am inclined to think, from the standpoint of the cost of the service and from the standpoint of the value of the service to the takers, that perhaps a scale with a moderate amount of slide in it comes nearer to doing even-handed justice between all the classes of consumers than anything else which can be suggested at this time.

Most of the arguments that have been presented to this Association and to this committee against the sliding scale have been directed against scales with excessive amounts of slide; and I think they are absolutely sound when used in that way. That is to say, scales that slide so much that the manufacturer gets water for a fifth or a tenth of the price per 1 000 gal. that is paid by the domestic consumer cannot be defended in this year 1916. They may have grown out of conditions that existed many years ago when the water-works business was young, and they may have been justified by earlier conditions. I think as a matter of fact

that they are mostly inheritances that have come down from earlier times, and whether or not they were right when they were adopted does not much concern us now. But at the present time such rates cannot be justified. They are discriminatory, and the arguments which have been presented against the sliding scale, as far as they relate to scales with such a great amount of slide, are absolutely sound, and the committee agrees fully that such excessive slides ought not to be permitted.

The committee did not think it was its function to determine absolutely the amount of slide in the scale, but it did express to the Association in no uncertain terms that it thought the amount of slide should very rarely exceed a 2-to-1 ratio.

That, gentlemen, is what the committee has tried to do in this report which is before you, and I want to add that this form of rates which has been recommended to the Association has already been adopted by the Hackensack Water Company, a company supplying water in the suburbs of New York to some 300 000 people more or less. That has been brought about largely by one member of our committee; and I understand from Mr. Sherman that it has also been adopted at Middletown, Conn., and it is also under consideration in a number of places where the question of rates is up at the present time. It isn't the committee's idea that adopting this schedule commits any one to it, or that any rates will be revised sooner than they otherwise would be. It simply sets up a standard to work to whenever the question of rate revision is up in your respective systems, and we hope that having such a standard which will be gradually worked to will result ultimately in working out and eliminating the erratic variations in rate schedules which exist at the present time and will put the whole business on a more rational and satisfactory basis.

(It was voted to accept the reports of the Committee on Meter Rates, and adopt the recommendations, and the committee was discharged.)

PROCEEDINGS.

Thirty-Fifth Annual Convention.

Portland, Me.,
September 13, 14, and 15, 1916.

The thirty-fifth annual convention of the New England Water Works Association was held in Portland, Me., September 13, 14, and 15, 1916, the official headquarters of the Association being at the City Hall, where the sessions of the convention were held and the Associate members displayed their exhibits.

Following is a list of the members and guests in attendance:

Honorary Members.

E. C. Brooks.
R. C. P. Coggeshall.
Desmond FitzGerald.
A. S. Glover.
F. E. Hall.
F. W. Shepperd.
G. A. Stacy.
R. J. Thomas. — 8.

Members.

G. H. Abbott.
J. W. Ackerman.
S. A. Agnew.
W. W. Albee.
F. E. Appleton.
F. L. Andrews.
James Aston.
F. S. Bailey.
M. N. Baker.
L. M. Bancroft.
F. A. Barbour.
H. K. Barrows.
G. W. Batchelder.
G. H. Bean.
F. D. Berry.
F. E. Bisbee.
H. W. Bishop.
C. M. Blair.
G. W. Booth.
George Bowers.
C. L. Bowker.
Bertram Brewer.
A. W. F. Brown.
Alvin Bugbee.
A. N. Burnie.
James Burnie.
L. W. Burt.
John Byrne.
J. M. Caird.
C. J. Callahan.
C. E. Chandler.
J. C. Chase.
J. H. Child.
E. S. Cole.
F. L. Cole.
W. R. Conard.
J. E. Conley.
V. R. Connor.
H. J. Cook.
H. R. Cooper.
G. K. Crandall.
H. C. Crowell.
John Cullen.
F. L. Cushing.
F. A. Darling.
F. J. Davis.
J. M. Diven.
A. O. Doane.
J. S. Dunwoody.
J. A. Durst.
C. H. Eglee.
E. D. Eldredge.
J. F. Ellis.
G. C. Emerson.
S. F. Ferguson.
G. H. Finneran.
R. J. Flinn.
F. L. Fuller.
M. S. Fuller.
W. E. Fuller.
W. S. Garde.
Patrick Gear.
H. T. Gidley.

T. C. Gleason.
H. J. Goodale.
W. M. Gooding.
F. W. Gow.
J. W. Graham.
S. M. Gray.
P. T. Gray.
Thomas Grieve.
A. S. Hall.
C. R. Harris.
A. F. Hart.
J. W. Hartigan.
L. M. Hastings.
W. C. Hawley.
D. A. Heffernan.
Edgar Hodges.
C. D. Howard.
A. C. Howes.
W. F. Howland.
E. W. Humphreys.
C. E. Johnson.
W. S. Johnson.
Willard Kent.
J. A. Kienle.
J. F. Kidder.
S. E. Killam.
A. C. King.
G. A. King.
John Knickerbacker.
Morris Knowles.
B. C. Little.
J. B. Longley.
W. J. Lumbert.
P. J. Lucey.
C. E. McDonald.
S. H. McKenzie.
W. A. McKenzie.
Hugh McLean.
W. H. McMahon.
H. V. Macksey.
A. E. Martin.
T. P. Martin.
John Mayo.
J. H. Mendell.
F. E. Merrill.
G. F. Merrill.
M. L. Miller.
A. R. Murphy.
J. W. Murphy.
W. G. Newhall.
R. J. Newsom.
John Parsons.
E. L. Peene.
C. E. Peirce.
H. E. Perry.
A. E. Pickup.
E. D. Pride.
E. W. Quinn.
J. H. Ranger.
J. F. Reagan, Jr.
A. A. Reimer.
J. H. Remick.
J. L. Rice.
L. C. Robinson.
J. A. Rourke.
P. R. Sanders.
H. W. Sanderson.
C. M. Saville.
J. B. Sando.
A. L. Sawyer.
W. P. Schwabe.
G. G. Shedd.
J. E. Sheldon.
C. W. Sherman.
H. L. Sherman.
H. H. Sinclair.
M. A. Sinclair.
G. Z. Smith.
G. H. Snell.
H. T. Sparks.
G. T. Staples.
O. H. Starkweather.
E. L. Stone.
W. F. Sullivan.
C. N. Taylor.
A. T. Thompson.
Milton Thorne.
J. L. Tighe.
J. A. Tilden.
A. H. Tillson.
R. K. Tomlin, Jr.
D. N. Tower.
C. H. Tuttle.
Lincoln Van Gilder.
L. L. Wadsworth.
J. H. Walsh.
C. L. Warde.
G. F. West.
N. M. West.
V. F. West.
R. S. Weston.
W. J. Wetherbee.
J. G. Whitman.
R. W. Wigmore.
E. K. Wilson.
F. J. Wise.
I. S. Wood.
L. C. Wright. — 171.

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Addressograph Co., A. L. Davis, H. B. Phillips.
Allen & Reid, Inc., Z. M. Jenks.
The American City, E. J. Buttenheim.
American Manganese Bronze Co., T. H. Addie, F. H. Linthicum.
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Engineering News, William Buxman.
Engineering Record, I. S. Holbrook.
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Garlock Packing Co., C. D. Allen, W. C. Marshall.
C. Godfrey.
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Simplex Valve & Meter Co., G. W. Stetson.
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The Smith & Abbott Co., J. H. Douglas, W. H. Goodwin, E. F. Hayden, R. C. Parker, S. F. Seavey.
Standard Cast Iron Pipe & Foundry Co., W. S. Setti, J. C. Atwell, S. D. Higley, H. F. Hoyt.
Union Water Meter Co., D. K. Otis, E. K. Otis.
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United States Cast Iron Pipe & Foundry Co., E. B. Grubb.
Wallace & Tiernan, Inc., M. F. Tiernan.
Warren Foundry & Machine Co., A. J. Girard, J. H. Morrison.
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R. D. Wood & Co., H. M. Simons, C. R. Wood.
Henry R. Worthington, W. F. Bird, Samuel Harrison, E. P. Howard, A. M. Pierce, H. F. Peake. — 107.

GUESTS.

MAINE.

Auburn, Mr. & Mrs. Andrew P. Cobb, Fred Gordon, John J. Lawler.
Augusta, Mrs. W. W. Albee, Mrs. Bradbury, Paul L. Bean, George C. Danforth, Miss Mary L. Doe, R. F. Leach, Robert M. Moore, F. J. McArdle, Ralph A. Parkers, Robert Morong.
Bangor, Charles W. Mullen.
Biddeford, Miss Helen M. Burnie, B. F. Cleaves.
Brunswick, Robert J. McDonald, Daniel W. Scribner, Edward W. Wheeler.
Cumberland Mills, W. E. Ferry, C. W. Mullen.
Gardiner, Mr. & Mrs. L. C. Ballard, S. D. Soule.
Houlton, B. B. McIntyre.
Kezar Falls, Allen Garner.
Lewiston, Ellen Callahan, Gertrude Callahan, T. W. Kerrigan, Louis Trial, Mrs. J. B. Longley.
Mechanics Falls, A. C. Frank.
Pittsfield, A. H. Burse.
Portland, Miss N. M. Alvord, George S. Beal, W. L. Blake, E. O. Boothby, Wilford G. Chapman, A. E. Clark, Harold B. Cole, Philip T. Conley, Mr. & Mrs. James W. Coburn, A. L. T. Cummings, John J. Devine, Mr. & Mrs. Edward Duddy, Eulalie Duddy, Harry A. Fuller, Mrs. P. Y. Gray, L. B. Griffin, Mrs. Donald Gardner, Mrs. C. R. Harris, E. C. Hersey, Mrs. Holmesburg, J. Arthur Jackson, Wilmot G. Jackson, Miss Kathleen Jarrett, William E. Jeffords, H. I. Jordan, Loring M. McKenney, George S. Merrill, Mr. & Mrs. W. B. Moore, Miss Florence Mosher, Daniel E. Moulton, P. H. Buswell, Miss Barbara W. Nelson, Mrs. S. H. Noyes, Frank O'Laughlin, Mr. & Mrs. E. L. Parrott, F. J. Perry, Rear-Admiral Robert E. Peary, E. E. Rogers, George R. Rooney, W. D. Sears, Harold F. Schnurle, Thomas Tetreau, M.D., Mrs. Milton Thorne, Winslow E. Townsend, Mr. & Mrs. Frank S. Wallace, Mrs. North M. West, Mrs. G. F. West, Mrs. Vernon F. West, Mrs. A. M. Pierce, James H. Heald.
Rumford, Miss Mabel Chase, H. L. Elliott, C. S. Osgood.
Sanford, Mrs. F. L. Andrews, Miss Marion Andrews.
Sebago, L. J. Johnson, William Johnson.
South Portland, Mr. & Mrs. Albert D. Boyd, Fred C. Boyd, Miss Lilly Kramer.
Waterville, Mrs. B. Brown, Mr. & Mrs. H. D. Eaton.
Westbrook, Joseph E. Perry.
Yarmouth, John A. Seabury, Miss Ada B. Seabury.

NEW HAMPSHIRE.

Berlin, Mr. & Mrs. C. C. Gerrish, Mrs. W. M. Gooding.
Derry, Mrs. G. H. Bean.

Manchester, Mrs. J. H. Mendell, L. H. Shattuck.
Somersworth, Mrs. John Parsons.

VERMONT.

Burlington, Julia Simays.

MASSACHUSETTS.

Andover, Mrs. Lottie M. Cole, Mrs. E. M. Weeks, F. E. Smith.
Arlington Heights, Mrs. J. D. MacBride.
Attleboro, Mrs. H. J. Goodale, Carrie L. Perry, Mr. & Mrs. H. A. Smith, Mrs. G. H. Snell.
Boston, Mrs. F. M. Bates, Miss Pearl L. Bates, Mrs. G. A. Caldwell, Mrs. A. L. Davis, Mrs. G. C. Emerson, F. J. Foley, D. L. Furners, E. G. Facy, Mrs. R. J. Flinn, Elizabeth R. Flinn, C. F. Glavin, J. M. Griffeth, Mrs. William S. Johnson, Mrs. A. S. Glover, Mrs. H. H. Kinsey, Joan M. Ham, Mrs. L. W. Richardson, J. J. Riley, Mrs. E. W. Shedd, Ellsworth N. Smith, Lester W. Tilden, Mrs. R. D. Wertz.
Bridgewater, Mrs. John Mayo, Miss Sarah W. Mayo.
Brookline, John Jackson.
Cambridge, Mrs. L. M. Hastings, T. J. Mulvahill, Patrick T. Mullin.
Chelmsford, Mrs. Walter McMahon.
Chicopee, William O'Brien, John Sullivan.
Cohasset, Mrs. D. N. Tower.
Dedham, Miss Grace M. Staples.
Fitchburg, Mrs. A. W. F. Brown.
Framingham, Annie G. Howland.
Franklin, Cathleen Darling.
Gardner, F. W. Dinwiddie.
Greenfield, Mr. & Mrs. W. T. Noyes, Mrs. G. F. Merrill.
Groton, A. A. Wood.
Haverhill, N. S. Foote.
Holyoke, Martha McLean, Mrs. Hugh McLean, Marion McLean, Mrs. J. F. Ranger, Madeline Sheldon, Mrs. J. E. Sheldon.
Leominster, Mrs. W. J. Wetherbee.
Lowell, Mrs. George Bowers, Miss Helen Bowers, Mr. & Mrs. C. H. French, M. H. Harrington, Mr. & Mrs. W. F. Hunt, J. E. Sullivan, Mrs. R. J. Thomas.
Malden, Mrs. F. E. Appleton, F. N. Prescott.
Marblehead, H. L. P. Wilkins, H. M. Wilkins.
Marlboro, Mrs. G. A. Stacy.
Medford, Mrs. F. W. Gow, Meriam D. Gow.
Melrose, Mrs. E. C. Brooks.
Middleboro, J. J. Pearson.
Millbrook, L. M. Peterson.
Monument Beach, Theodore Chaffin.
North Scituate, Mrs. S. A. Agnew, Miss E. A. Agnew.
Norwood, James Drommay.
Onset, Neddie Eldredge.
Oxford, Mr. & Mrs. A. M. Chaffee.
Pepperell, Mr. & Mrs. Perley J. Blake.
Pittsfield, Mrs. F. J. Wise.
Reading, Mrs. L. M. Bancroft, Mrs. A. E. Davis.
Revere, Carl G. Richmond.
Salem, W. T. Howe.
Saugus, Mrs. A. F. Hart.
Somerville, Mr. & Mrs. D. L. Dow, Mrs. Samuel Harrison, Mrs. F. E. Merrill, J. M. Towle.
Southbridge, Mrs. C. H. Abbott.
Uxbridge, W. E. Rawson.
Wakefield, Mrs. O. H. Starkweather, R. E. Starkweather, O. A. Starkweather.
Walpole, H. C. Battles.
Waltham, Mrs. Bertram Brewer,

George W. Forbush, Ella A. Moulton.
Ware, Mrs. T. E. Gleason.
Webster, S. G. Wylie.
Wellesley, Mrs. F. L. Fuller, Mrs. C. N. Taylor.
West Springfield, B. E. Fox, Mrs. T. P. Martin, Mr. & Mrs. J. F. Whitney.
Weymouth, Mrs. A. R. Taylor.
Woburn, James Hagerty.
Worcester, Florence M. Rice, Mr. & Mrs. C. I. Rice.

RHODE ISLAND.

Narragansett Pier, Mrs. Willard Kent.
Providence, L. Brightman, Robert Gray, Walter Hazelton, Mrs. G. H. Lewis, Mrs. I. S. Wood.
Woonsocket, Mrs. Z. M. Jenks.

CONNECTICUT.

Ansonia, Mrs. J. F. Davis.
Hartford, Mrs. C. M. Saville, Humphrey Sullivan.
Middletown, J. P. Baeon, Thomas Hoops, Jr., Arthur Losey, G. C. More, H. S. Warner.
Naugatuck, D. P. Mills.
New Haven, Mrs. C. M. Blair.
New London, Mrs. G. K. Crandall.
Norwich, Fannie L. MacKenzie, Mrs. S. H. MacKenzie.
Thompsonville, Mrs. H. R. Cooper, Mrs. W. P. Schwabe.
Wallingford, Mrs. J. H. Child, Marjorie F. Child, Mrs. W. A. MacKenzie.
Yalesville, Miss Mabel McKenzie.

NEW YORK.

Auburn, Mrs. J. W. Ackerman.
Brooklyn, Mrs. H. F. Yoyt, Miss Ambrose.
Johnstown, Mrs. Edgar Hodges.
New Rochelle, Mrs. M. F. Tiernan.
New York City, H. W. Ford, Mr. & Mrs. G. L. Garrison, F. Gleason, Mrs. C. L. Lincoln, M. L. Northrop, Mrs. F. W. Shepperd, Fred Shepperd, E. E. Smith, Mrs. W. H. Van Winkle, Miss E. K. Wilson, R. M. Mowry.
Rensselaer, Mr. & Mrs. R. L. Hinkley, Mr. & Mrs. S. A. Russell.
Rochester, Mrs. B. C. Little, Helen D. P. Little.
White Plains, C. P. Abbott.
Yonkers, Mrs. E. L. Peene.

NEW JERSEY.

Atlantic City, Mrs. C. Godfrey, Mrs. L. Van Gilder.
Bound Brook, Mrs. W. B. R. Mason.
East Orange, Mrs. G. W. Booth.
Perth Amboy, Mrs. Thomas Grieve.
Ridgewood, F. W. Simonds.
Salem, Mr. & Mrs. T. W. Gayner.
Trenton, Mrs. Alvin Bugbee.
Weehawken, Earle Talbot.

PENNSYLVANIA.

Berwick, M. J. Casey.
Braddock, W. H. Williams.
Pittsburg, Mrs. Morris Knowles, Mrs. F. N. Speller.

INDIANA.

Wabash, Mrs. T. W. McNannie.—301.

SUMMARY OF ATTENDANCE.

Honorary members	8
Members	171
Associates	107
Guests	301
	587

MORNING SESSION, WEDNESDAY, SEPTEMBER 13, 1916.

The convention was called to order at 10 A.M. by President William F. Sullivan, who said:

Your Honor and Ladies and Gentlemen, — The thirty-fifth annual convention of the New England Water Works Association opens under auspicious circumstances in this beautiful city, whose native air is pure and sweet; a city rich in historical and literary associations, immortalized by the poet Longfellow, and you and I may go, as he went many times, to " Deering's Woods, so fresh and fair."

Longfellow said, " A boy's will is the wind's will, and the thoughts of youth are long, long thoughts."

So, all you overworked and nerve-racked water-works men, be boys again in Portland, and instead of your will being the wind's will, let the winds of Portland be your will and waft you around the hospitable weather vane, which has been provided by our hosts, the people of Portland.

We are indeed fortunate in having this magnificent municipal building for our uses. I might say, while we are in Portland, let us remember that we are drivers of water wagons, and that the spirits of Portland's hospitality are tempered by the shade of that venerable apostle of prohibition, Neal Dow.

I cordially welcome you here, guests and members, to this our annual convention, and I know our hosts are going to cordially welcome all of us to " 'way down East." The committee of arrangements has prepared and planned an excellent program, which I know will not fail to satisfy. Headed by Mr. Johnson, it has done its work well, and I know that the committee will take care of almost our every need. Mr. Graham and the local committee have done such splendid work that we cannot fail to appreciate it. The Portland Chamber of Commerce has lived up to its reputation as a live civic body. Some boards of trade or chambers of commerce are mere names only, but here in Portland you have a living, breathing, boosting organization, which knows how to present Portland's attractions and advantages as a city to live in and to do business in. They, too, welcome us to this busy and prosperous city, and I know that when we leave it will be with regrets and a firm determination to come again.

The Committee on Exhibits has done itself proud, as you can see by looking about, and we water-works men can gain a fund of useful information by availing ourselves of the opportunity to inspect and investigate the last word in supplies and equipments which have been so generously provided by our friends, the manufacturers.

In looking over the program, you will see that it is as nearly complete as time and work can make it. The entertainment portion has not been forgotten, and those who were fortunate enough to be on the boat, last night, know that the party was pleasant and agreeable, and a proper spirit of fellowship was shown; and that is what we want in this convention, — a convention that will show warmth and a good spirit and a good-fellowship.

However, let us work while we work and play while we play, and the real serious work of this convention is that the members attend the sessions faithfully, listen to the high-grade and practical papers, and then fully and freely discuss them; for it is by this means principally that we know what is going on in the water-works world. The papers are the text-book, from the primer to the sixth reader, of our business. The discussions tell us how the other fellow does it. So let us buckle right down to business during a portion of our short eight-hour work day, so that the rest of the time we may enjoy the play which has been so generously provided for us.

Longfellow said, " Often I think of the beautiful town that is seated by the sea. Often in thought go up and down the pleasant streets of that dear old town."

That beautiful town is now the great city of Portland, the metropolis of Maine, and those " pleasant streets " are now the busy marts of trade and highways of commerce. It is our privilege and our honor to have with us to-day a man who has been selected and elected by the people of Portland as its chief magistrate, and this man is going to greet us to-day; welcome us to Portland. It gives me much pleasure to present to you the Hon. Wilford G. Chapman, mayor of Portland.

Mayor Chapman. *Mr. President, Ladies and Gentlemen of the Association*, — I am more than glad to welcome an association of experts to our city. I should perhaps appear immodest if I

should attempt to add anything to the glowing words of praise which your president has given to us. We are a city of 63 151 inhabitants, according to the United States census estimate of 1915. The Chamber of Commerce makes our population 75 000 — for purposes of its own; but the United States census will perhaps appeal as much to men of science as the returns of the Chamber of Commerce, with all due respect to my good friend Mr. Moore.

Notwithstanding some things that you may see in the organs of certain interests, it is true that the people of Maine, for the most part, use Sebago water to drink and to bathe in. Our water company here in Portland is out of politics, managed by a non-partisan commission of men who know sound business principles, and who employ only experts to administer the affairs of the company.

I regret very much that our old friend Mr. Dyer, who was one of the men, if not the man, who first turned on Sebago water in the city of Portland, who has been identified with the interests of the company from then up to the time of his death, and who has been, through it all, a loyal, useful, good man; an expert in this line of business — I regret very much that he is not here to greet and welcome many of you who I understand have been connected with him in this line. As long as the water business of Portland continues to be managed in the future as it has been in the past, for the interests of our people, there will be no politics in it. In fact, I have an idea that is what takes a thing out of politics, to manage it so well that the people are satisfied. Possibly, in the far and distant future, when the people of this community and the country are wise enough, we may take some other questions out of politics in the same way, as, for instance, the tariff and the rum question.

But enough along that line. I am more than glad to welcome this Association. I hope that our citizens will take advantage of this opportunity to learn all that they can learn about these different water appliances. This thing is true about scientific men of the present day, that they not only know themselves, but they try to make others know. That is why I am more than glad, in behalf of the citizens of Portland, to welcome a group of scien-

tific men, who know something better than any one else knows it, and who are here not only to communicate their ideas to each other, but to the people at large.

We are very glad to congratulate ourselves and congratulate the convention on the weather that we have to-day. We mean to keep a constant supply of that kind of weather for conventions. Sometimes we run short, but fortunately to-day we have got the very best weather that the world produces anywhere, with a full moon to go with it. I hope and believe you will have one of the most successful conventions in your history. I am informed that the exhibits are finer than ever before, which is the way it should be. Wherever you hold your convention, each year should be the best.

Mr. President, ladies and gentlemen of the convention, you are welcome to Portland.

PRESIDENT SULLIVAN. We have with us to-day a man who represents an office which does not require much introducing, because these officers are always able to introduce themselves, and tell us the good things of any city or community. It gives me much pleasure to call upon Mr. W. B. Moore, executive secretary of the Chamber of Commerce.

MR. W. B. MOORE. *Mr. President, your Honor, Ladies and Gentlemen,* — Unfortunately for you, I have been called in to substitute to-day for the president of our organization, who has been called from the city on account of fatal illness in his family. My remarks are going to be very brief, because this convention is a matter of business, and not talk. Your President and his Honor have said practically all of the good things about Portland, and given to you the glad hand of welcome. There has been just one fact overlooked, however, and that is in regard to the keys of the city of Portland. It is customary, as many of you know, on occasions of this kind, to state that the keys of the city are yours. Much to the credit of Portland, a great many years ago, following the time that your President referred to, a key was made in behalf of the city of Portland, to use on occasions of this kind. That key, however, was taken out one night and thrown into the waters of Casco Bay, and the town has been open to everybody since. It is open to you. We want you to come here

time and time again. We want to do everything possible to make your stay in this city one of interest, one of value, one of instructive and constructive work. If there is anything you see that is undone, tell us, and we will make it right.

Portland, as the metropolis of the state of Maine, as a distinctive city, America's sunrise gateway, as represented by the Chamber of Commerce, extends to you a glad welcome. We want to show you all the hospitality for which this city is noted, and to make your visit so nice that this will be the permanent convention place of the New England Water Works Association. I thank you.

PRESIDENT SULLIVAN. It is our pleasure to have with us to-day a man who represents those who have been selected to manage the water supply for this city of Portland, and for a large district hereabouts. We are, and will be, indebted during the convention to the Portland Water District for many courtesies. It gives me much pleasure to present to you William L. Blake, Esq., president of the board of trustees of the Portland Water District.

MR. WILLIAM L. BLAKE. *Mr. President, Ladies and Gentlemen,* — In behalf of the Portland Water District, it gives me pleasure to join with his Honor the Mayor in welcoming you to our city. Compared with the great water-works systems of New England, the Portland Water District has perhaps very little to command your attention. As you well know, we have what is known as a gravity system. We have no important pumping system to show you and interest you. We know that this is one of the great and interesting features of many of your New England states. We have no filtration plant to maintain, and you all will feel that we are very fortunate in being able to supply Portland with an efficient water supply of such purity and character without these adjuncts.

The trustees of the Portland Water District and its employees will do everything that is possible that you may enjoy your visit here. Just a word about Lake Sebago. As you well know, we have one of the finest water supplies in the country. The lake is picturesque, and certainly none of you want to miss the entertainment that has been provided for you, and I hope that you will all, to-morrow, see that nothing stands in the way of your taking the trip. Mr. President, I thank you.

PRESIDENT SULLIVAN. On behalf of the New England Water Works Association, I sincerely thank his Honor the Mayor, Mr. Moore, and Mr. Blake, for their kind words of greeting, and I want to assure them that the New England Water Works Association esteem it a pleasure to be here, and we shall carry away with us fond recollections of Portland, and of Portland's public men.

We now have some business to transact, and, as we expect Admiral Peary here in a short time, I would like to ask our friends and guests and members to remain until he arrives. Our business may be a little dry for our guests, but I know that the Admiral's talk will be a rare treat for us all.

The Secretary read the following names of applicants for membership, all of whom had been properly endorsed and approved by the Executive Committee:

Active:

C. Godfrey, Atlantic City, N. J.
James P. Allardice, Fall River, Mass.
James Aston, Pittsburg, Pa.
Charles S. Beaudry, Lexington, Mass.
H. W. Bishop, treasurer Boothbay Harbor Water System, Boothbay Harbor, Me.
Theodore L. Bristol, president and manager of the Ansonia Water Company, Ansonia, Conn.
H. L. Elliott, superintendent Rumford Water District, Rumford, Me.
Robert Fletcher, Dartmouth College, Hanover, N. H.
Seba A. Holton, treasurer Board of Water Commissioners, Falmouth, Mass.
William J. Lambert, superintendent Public Works, Saugus, Mass.
William S. Nolan, water-works engineer and contractor, East Boston, Mass.
P. Von Weymann, Pishpek, Russia.
John Young, inspector Department of Western Canada Fire Underwriters Association, Winnipeg, Man.
Fred C. Gamewell, treasurer Palmer Water Company, Palmer, Mass.
George A. Hatfield, superintendent Sidney Water Works, Sidney, Ohio.
Howard C. Kinney, mining engineer, Waterloo, N. Y.
William E. Merck, superintendent of Water Works, Jackson, Ga.
Jean A. Clameau, town engineer, Chicoutimi, Canada.
Thurston C. Culyer, Purdy's Station, N. Y.
George E. Mann, Woodsville, N. H.
James Mullins, Springvale, Me.

Adolph Theriault, Nashua, N. H.
Ezra B. Whitman, Baltimore, Md.
Francis D. H. Lawlor, superintendent Citizen's Water Company, Bellington, Ia.
C. S. Rathburn, assistant secretary Boise Artesian Hot and Cold Water Company, Boise, Ida.
Jesse M. Worthen, M.D., superintendent Charleston Light and Water Company, Charleston, S. C.
William L. Blake, president Portland Water District, Portland, Me.
John A. Hartigan, commissioner and superintendent Longmeadow Water Company, Longmeadow, Mass.
Henry F. P. Wilkins, manager of Water Department, Marblehead, Mass.
Charles R. Preston, Lowell, Mass.
Herbert L. Hapgood, water commissioner and superintendent, Athol, Mass.
William F. Hunt, Lowell, Mass.
Maurice E. FitzGerald, superintendent of South Hadley Falls Water Works, South Hadley Falls, Mass.
Michael H. Harrington, Lowell, Mass.
Frederick H. Hapgood, Holyoke, Mass.
Earle Talbot, treasurer and general assistant superintendent Hackensack Water Company, Weehawken, N. J.
Charles E. McDonald, superintendent of water works, Waterbury, Conn.
Carl G. Richmond, superintendent of Public Works, Revere, Mass.

Associate:

Ford Meter Box Company, Wabash, Ind.
American Manganese Bronze Company, Philadelphia, Pa.
Carbic Manufacturing Company, New York City.
F. S. Eggleston, Jr., manufacturer of pneumatic and electric machinery, Roslindale, Mass.
Hartford Contractors' Supply Company, manufacturing special contractors' machinery and water-works tools, Hartford, Conn.
C. M. & H. T. Plummer, manufacturers of pipe and fittings, Portland, Me.
United Brass Manufacturing Company, Cleveland, Ohio.
Winslow & Company, Portland, Me.
Garlock Packing Company, Boston, Mass.

On motion duly made and seconded, the Secretary was empowered to cast the ballot of the Association in favor of the candidates, and, he having done so, they were declared by the President duly elected members of the Association.

PRESIDENT SULLIVAN. The meeting is now open for new business.

MR. C. W. SHERMAN. On behalf of the Committee on the Dexter Brackett Memorial, I have the pleasure to submit the report of the committee, and the medal, which has been prepared for a prize, to be awarded annually for the most meritorious paper.

The report of the committee has been printed and is on file at the Secretary's office, so I will not attempt to read it, but give only the salient points at this moment. The committee sent to the entire membership of the Association, giving an opportunity to subscribe for this memorial, and received a total of $1 281.50, from 101 contributors. The expense of the committee was comparatively slight, so that after paying $1 000 to establish the medal itself, we have remaining a balance of $197.34, which we turned over to the Association with the medal. We do not suggest that this money be kept as a fund, but that it be put in with the other moneys of the Association, and that the Association assume the responsibility, from its regular funds, of striking off a medal each year for the best paper.

In accordance with our instructions, we have also drafted rules for awarding the medal, or, rather, suggested rules which should be considered and adopted by the Association. In the printed report is a list of the subscribers, and the rules which we would suggest for adoption. Such rules should not, of course, be adopted offhand and without consideration, neither should the Association bind itself at all times to an annual expense without a carefully prepared vote, and without consideration by its Executive Committee. The committee has accordingly drafted the primary resolution, which I will read:

Whereas, the Committee on Dexter Brackett Memorial has submitted its report, accompanied by the medal designed under its direction, the balance of funds collected by it amounting to one hundred ninety-seven dollars, thirty-four cents ($197.34), and a draft of rules governing the award of the Dexter Brackett Memorial medal; and whereas the said committee has recommended that, in consideration of the donation of said memorial

medal and sum of money, the Association assume in perpetuity the payment of the annual expenses connected with striking off and engraving medals and furnishing cases, which recommendation has been approved by the Executive Committee; therefore, be it resolved,

1. That the New England Water Works Association accept, and it does hereby accept, the Dexter Brackett Memorial medal and the accompanying sum of one hundred ninety-seven dollars, thirty-four cents ($197.34).

2. That, in consideration of the receipt of this medal and sum of money, the Association assume, and it does hereby assume, the obligation in perpetuity to care for the dies and to pay the annual cost of striking off and engraving medals and furnishing cases for them.

3. That the draft of rules governing the award of the Dexter Brackett Memorial medal is hereby referred to the Executive Committee for consideration and amendment or adoption, at its discretion.

4. That the report of the Committee on Dexter Brackett Memorial is hereby accepted and the committee discharged.

Before you put that resolution, I would say that I have here a proof copy of the medal, which I should be very much pleased to show to any one of the Association, and I have a cashier's check, which I will turn over.

[On motion, duly made and seconded, it was voted that the resolution be accepted and adopted as read.]

PRESIDENT SULLIVAN. You have heard the remarks of Mr. Sherman, and I know it would be well worth your while to examine the medal and to remember the man in whose honor it was gotten up.

We have with us to-day Mr. Graham, general manager of the Portland Water District, a man who has done much work to further the success of this convention. I am going to call upon him for a few remarks.

MR. JAMES W. GRAHAM. *Mr. President, Ladies and Gentlemen,* — I simply want to make a few explanations in regard to the entertainment. The Fidelity Trust Company, which occupies

the tall building in the Square, extends an invitation to the members and guests to visit the building and go on the roof, where you can have an excellent view of the city, the harbor, and the mountains. If you will call at the banking department and inquire for either Mr. Weeks or Mr. Gould, they will be very pleased to take you up.

In regard to the excursion for this afternoon, we want to leave immediately after the adjournment of the morning session. I would like you to pass out the front door, where a group picture will be taken on the steps of the city building, and then we will proceed at once to the boat, five minutes' walk. A clambake will be held at Long Island, probably about one o'clock, after which the remainder of the afternoon will be spent in a sail through Casco Bay, among the islands.

For Thursday, there is a trip to Sebago Lake and Naples. The party, as you will notice from the program, is split into sections, one section going out by special train from the Union Station at one o'clock to Sebago Lake, where they will transfer to two steamers, which will be in waiting, which will take them across Sebago Lake and through the Songo River to Naples, arriving about four o'clock.

The automobile section will leave City Hall, this building, at one o'clock. Automobiles will be on the Myrtle Street side, and go by the way of Poland Springs to Naples, arriving there at four o'clock. The Rickers at Poland Springs have very kindly consented to allow us to visit the grounds, the spring, and see the manner in which they prepare their water for the market. They will have guides there to show you around. The only restriction that they have made is that if there are any children in the party, they will not be admitted to the grounds.

The Chamber of Commerce have been working very hard to secure a sufficient number of automobiles, but we find that a great many people in the city who own automobiles are at this time taking vacations, so that the cars are limited, and I would request the local members to take the trip by rail and boat, and return the same way. The trip by automobile is about forty-five miles, and over a dusty road. If there are any who prefer to go and return by the boat, we can accommodate them that

way very easily. The tickets for this excursion will be given out on the sail this afternoon.

On Friday Mr. West has arranged an entertainment for the ladies at Riverton Park, at 3.30. A special car will leave the waiting-room in Monument Square. After the adjournment on Friday afternoon, the gentlemen of the party who care to may go out to Riverton and have lunch there, or lunch here in the city and then go out afterwards. If we can get a sufficient number, the managers at the Park say that they will furnish a special dinner for us. Those who are intending to go out there for lunch will kindly leave word at the Secretary's office, in order that we may know how many to prepare for.

In the evening, there will be a short business session in the open-air theater, after which an entertainment which has been prepared by the Water District people, of local talent, assisted by some of the members of the Association.

Regarding the Saturday trip to the White Mountains, the Maine Central Railroad have very kindly given us a two-dollar rate for the round trip. The tickets will allow you, if you wish, to stop over, returning Sunday. The train leaves Saturday from the Union Station at 8.45, arriving at Fabyan's at 12.28. If you care to return that day, the return train from Fabyan's is at 5.03, arriving at Portland at 8.27. Those who desire to stay over may return Sunday at 2.30, arriving at Portland at 5.45. Dining-car service on all trains.

On motion of Mr. Stacy, duly seconded, it was voted that the President appoint a committee of five to nominate officers for the coming year.

The President subsequently appointed the following committee: Charles S. Sherman, Boston, Mass., chairman; A. W. Cuddeback, Paterson, N. J.; James Burnie, Biddeford, Me.; R. C. P. Coggeshall, New Bedford, Mass.; George Batchelder, Worcester, Mass.

Mr. Taylor. *Mr. President, Ladies and Gentlemen,* — It occurred to me this morning that perhaps it might add to the enjoyment of the members and guests to visit the new cold-storage plant which has recently been erected in Portland, and on behalf of the New England Cold Storage Company I extend

to the members and guests of the New England Water Works Association an invitation to visit that plant. If the President or officers will arange for a certain hour, I will see that there are guides or officers of the company to show you around. That hour has not been arranged for, that I know of.

PRESIDENT SULLIVAN. I know we all appreciate the kind invitation of Mr. Taylor, and I hope many members will avail themselves of the opportunity. Our invitations in Portland are coming thick and fast. I am going to call upon Mr. Graham again to say a word.

MR. GRAHAM. The Portland Stoneware Company, Winslow & Company, extend an invitation to the Association to visit their works and inspect their process of manufacturing sewer pipe. I think this will be very interesting to you, particularly the engineers. I think that Mr. Johnson, the chairman of the Convention Committee, has arranged for some particular hour in which this visit may be made, and it will be published in the daily waterworks record, and also perhaps an announcement will be made at the meeting.

PRESIDENT SULLIVAN. The Oxford County Agricultural Society extends a cordial invitation for our body to attend the fair on any of the three days. There are special trains from Portland, September 13 and 14; one fare and free admission for our members.

I want to thank all the gentlemen for their kind invitations. Is Mr. Cole here?

MR. COLE. At the June meeting of the American Water Works Association, a committee was appointed to confer with the committee of this Association in regard to a uniform blank to be used by the water-works associations throughout the country in compiling statistics. The report was adopted and will be printed. The sentiment that a committee of this Association should be appointed was very pronounced. It is hoped that at this meeting you will appoint a committee to work with that committee.

I move that the President appoint a committee to confer with the committee from the American Water Works Association, to prepare a uniform blank form of accounting for water consumption.

PRESIDENT SULLIVAN. Mr. Sherman, you were on the other committee. Have you anything to say on the motion?

MR. C. W. SHERMAN. I don't know as there is anything to say. This Association has a committee which reported two or three years ago. Its duty was primarily to collect statistics, taking cities of different types. They presented a rather voluminous report, and went out of existence. We have no committee at the present time. It seems to me that it would be proper and desirable that we should appoint a committee to coöperate with the corresponding committee of the American Association, as Mr. Cole suggests.

[Mr. Cole's motion was put and carried.]

The President subsequently appointed the following committee: Edward S. Cole, New York, chairman; D. A. Heffernan, Milton, Mass.; Percy Sanders, Concord, N. H.; E. W. Kent, Newport, R. I.; Caleb M. Saville, Hartford, Conn.

PRESIDENT SULLIVAN. The paper, "The Water Supply of Portland," by David E. Moulton, Esq., of Portland, has been postponed until this evening, for the reason that Mr. Moulton has a number of slides showing the water supply of Portland, and Sebago Lake. It is an excellent paper, and I trust that not only the members but the ladies will attend the evening session and get a bird's-eye view of Portland's water supply.

It is many years ago since we were thrilled by the explorations and hardships of Lieutenant Peary. Again and again we followed him, year after year, in spirit as Captain Peary. Did ever a man stick to such hard and dangerous undertakings for the glory of the people of the United States? Then came the final, the superhuman dash, the climax of all modern explorations.

After that, the applause of a grateful nation, the proper recognition by the government, and we have with us to-day the man who braved the hardships, conquered the unknown, and finally planted the stars and stripes on the top of the world, Admiral Robert E. Peary.

ADMIRAL ROBERT E. PEARY, U.S.N. *Mr. President, Ladies, and Gentlemen of the New England Water Works Association,* — I very much appreciate your President's eloquent introduction, but the incidents of which he speaks are ancient history to-day;

but you are an organization and we a nation that is more interested in things of the present and the future than in matters of the past, so I am not going to touch this morning at all on Arctic matters, or the North Pole. The climate is very comfortable and suitable here just as it is at present.

I have very much appreciated the compliment of being asked to speak here to-day, and I have specially prized the opportunity, because it gives a chance to say two or three words to an organization made up of thinking and doing members, the type of our American citizenship, and I am going to speak to you, just briefly, on the subject which to me to-day is the most important one for this nation. It sometimes seems to me as if it were the only issue before us to-day; that is, the question of putting ourselves in the shape that is due ourselves, as one of the greatest nations and powers in the world, and putting ourselves in a shape that we *must* be in, if we expect to continue our national existence and integrity; the general subject of "Preparedness," but with special reference to what seem to me three vital fundamentals, and the three biggest items of that national preparedness. We have suggestions, we have theories, we have talk in regard to preparedness, but, in it all, it seems to me as if there are three big, broad, fundamental things which we must have, and then let the others come as accessories.

The first of those things is a fleet of sixteen thirty-five knot battle cruisers, armed with 16-inch guns; eight of those magnificent ships in the Atlantic, eight in the Pacific, complete with all accessories of torpedo boat destroyers and submarines and hydroaeroplanes; a fleet to put the navy of the United States in unquestioned second place among the navies of the world, and insure absolutely our coastal cities from continued liability to attack by the battle cruiser division of any hostile power, and, during peace, to look out for that magnificent commerce in all the seven seas of the globe which is certainly, with the solution of questions still pending abroad, coming to these United States of America. There is the first fundamental thing in my opinion, a thing pertaining to our first line of defense, the navy and the sea.

Next, we need an air service commensurate with our importance, and sufficient for our protection; a separate, independent de-

partment of aeronautics, with a seat in the President's Cabinet, independent of the army or the navy; having under its full control a comprehensive system of air coast defenses for the entire country; having under its full control a system of great aviation schools in the principal geographical divisions of the country; having under its full and undivided control the development of the possibilities, civic and commercial, of the aeroplane and of aeronautics. With the mechanical genius, with the resources, with the means of this country, under concentrated and undivided attention, such a department can be and will be eventually made one of the greatest features of our civilization, and will, in the near future, be more important for our national safety in case of trouble than our army and our navy combined.

That may seem strong language to you. Later, I am going to quote to you in corroboration of that broad statement. This is the second item, pertaining to our second line of defense of our coast, pertaining to the air.

Third, some system of universal military education and training, similar to the systems now in existence in Switzerland and in Australia, modified in some details, perhaps, to fit it particularly to our especial requirements, but some system that will educate and train every youth, every able-bodied man in the country, in military questions, and still without imposing upon the nation the enormous expense of a standing army, and without taking these youths and business men from their ordinary professions, callings, and avocations; not taking them from the prospective capabilities of the country. Switzerland is a striking example of such a system. There, with a population essentially the same as that of Massachusetts, four millions, with an area about twice that of Massachusetts, this little, commercial, particularly non-militaristic country of Switzerland at a sudden call, two years ago the first of last August, sent four hundred thousand trained citizen soldiers to her frontier, — ten per cent. of her entire population, — and, as a result of that system, and of that object lesson, Switzerland from that time until now has been an island in a raging sea of war, and has been immune from attack, aggression, or insult.

Now, what would that mean for us here? It would mean,

with a similar percentage of efficiency, that in a sudden call or emergency these United States of America could send to their defense, or have on the way to their defense in forty-eight hours, ten million trained citizen soldiers, and that very fact would be absolute insurance to us against trouble.

Perhaps the first thing that occurs to most of you is this, " What about the expenses? What about the enormous expenses of these suggested things? " Can we stand them? Do you know the equivalent of three weeks of present war cost, just to Great Britain alone, not counting in her allies; not counting in the central powers? Three weeks of present war cost, just to Great Britain alone, would give us that magnificent fleet of sixteen battle cruisers, the fastest and the most powerful in the world, with all their accessories.

Three days' present war cost, just to Great Britain alone, would give us this comprehensive coast defense system of which I shall speak a bit more in detail later; and two days of present war cost, just to Great Britain alone, would enable us to inaugurate a system of universal military training and education in this country.

How shall that expense be met? In my own personal opinion, while I am not a statesman or a financier, it seems to me that the simplest way in the world would be by a national bond issue; a bond issue to accomplish two objects, — first, to distribute that expense of insuring the national integrity between this present generation and the next, and perhaps the next; and, second, that bond issue, in small denominations, would give the small investor all through the country the safest and best possible means of investment.

In these various branches of preparedness, there is no one in which this country to-day is so woefully deficient, absolutely lacking, in fact, as in aeronautical preparedness. I have suggested — I have urged for something over a year past — a system of aero defense of our coast. The personnel and the material of that system, pending an emergency and the necessity which would demand its use in a military sense, could be utilized for life-saving purposes along our coast; for reporting ships; carrying aid to wrecks or disabled ships along our coast, but, at the same

time, it would be perfecting for us an aviation personnel, of which to-day we have nothing. That is one of the first steps to give us aeronautical preparedness, that is, a class of aviators just as numerous as our present class of chauffeurs. We need not tens, or dozens, or hundreds, but thousands of men who are capable of jumping into an aeroplane and driving it, as you drive your car. To-day we have only perhaps one or two hundred in both arms of the service, the army and the navy. I doubt if more than a hundred serviceable aeroplanes could be put in commission at this moment, and yet the army of the United States had the first aeroplane of any army in the world, and our navy had the first hydro-aeroplanes of any navy in the world. Probably there is no country in the world to-day that has the material and the personnel of such an aviation department as the United States of America, unless it may be France, and we have the advantage of France in that while the character of our material is young men, wiry, sandy, cool, courageous, the ideal type for the aviator, and the equal to the character of hers, which are recognized as the best aviators in the world to-day, we have so many more of them that we could have the finest air service in the world.

Very briefly, let me outline to you the plan of this aero coast defense system, which comprises two parts, — an aero coast patrol, which is really the picket line, and a series of squadron stations. If I can visualize to you in just a moment or two this coast patrol matter, it is this. If you will assume our coast from Eastport, Me., to Brownsville, Tex., and from San Diego up to Cape Slattery; assume those coasts divided into sections of about a hundred miles each; assume each of those sections with a coast patrol station, having two or three sturdy, heavy-weather aeroplanes, with hangars for protecting them and machine shops for repairs, aviators and mechanicians, and the like; imagine that continuous around the entire coast of the country, and that one of these hydro-aeroplanes will all the time be out on what we will call its beat, fifty miles out from the coast. We say fifty miles now. By the time the system is in operation, a year from now, the perfection of the aeroplane would be such that these aviators can be a hundred miles out from the coast, two thousand feet up in the air in clear weather; each machine carrying two persons,

the pilot and the observer; with a light wireless apparatus by which the machine can communicate with the shore, and with powerful glasses for scanning the horizon. This machine will be out from fifty to a hundred miles from the coast, two thousand feet in the air; each machine, in its section, traveling back and forth like a policeman on his city beat; the machine in the next section contiguous to it also traveling back and forth over its beat; the result being a continuous cordon or curtain of these hydro-aeroplanes around the entire country. When the system is in effective commission, the probabilities are that no ship could pass that cordon without being detected, and its presence reported to the shore by the wireless apparatus, and, if it were the case of a hostile fleet, the number and character of the ships and the probable destination reported to Washington by wireless; so that such orders as might be necessary could be sent out to the submarine flotillas, and the battleship and battle cruiser squadron and the aero-squadron. That is just the picket line, the picket line which is the modern evolution and development of that original sentinel, the cave man clad in skins, armed with a stone hatchet, crouched at the mouth of the cave that protected his family or portions of his tribe; watching for the approach of some hostile force. To-day, our picket line is the bird man, way up in the air, miles off the coast.

That is only the picket line. To make the aero defense, coast defense, complete and sufficient of itself, there is needed in addition to that the effective military, as you might say, or fighting part of the aero-defense, and that would be comprised in squadron stations at or near every one of our great coastal cities, Portland, Boston, New York, Atlantic City, abreast of Philadelphia, Fortress Monroe, Charleston, Pensacola, New Orleans, and then the same on the Pacific Coast. At or near each of these squadron stations would be one or two or three hundred aeroplanes parked, like the tents of the summer encampment of our national guard. If any such number of aeroplanes as that near our great cities seems astounding, remember that just such conditions as that are to-day in existence on the other side, and one of the reasons why Paris is not frequently visited by the Zeppelins is because there are hundreds of aeroplanes about the city, ready for instant use.

Let us see how this system of coast defense works, supposing it is in commission. Let us imagine that the hydro-aeroplane coast patrol picket line gives notice by wireless of the approach of a hostile fleet. The next step is to send out a cloud of scout aeroplanes from the squadron stations; send them out in numbers sufficient to completely overwhelm and beat down any number of aeroplanes which could be transported here upon the decks of the hostile fleet and its transports. What become the conditions then? Simply the condition of a blind man struggling with a man in the possession of his senses. The hostile force has no means of determining our strength or disposition, while we have every means of determining his strength and disposition. And next follow the great battle biplanes or triplanes which carry tons of high explosives. There are squadrons of these, and perhaps in the near future they will carry aereal torpedoes, with which to amuse the hostile fleet. Should the major portion or any considerable portion of such a fleet escape this first off-shore attack and get near enough to the coast to effect a landing, as you will recall was effected on the coast of Long Island in the naval maneuvers quite recently, then comes the next step, in which every aeroplane and every aviator in that region would be commandeered in the same way we would commandeer every automobile and every chauffeur to transport supplies or troops. Every aviator and every aeroplane would be commandeered and supplied with explosives to use at that most vital next step of the enemy, the attempt to land a party.

Now, what I have said to you in regard to numbers of aeroplanes that we need in this country probably seems, even to the best-read and best-informed among you in regard to aeronautics, as a dream, or at least something only of the remote future. As a matter of fact, it will be a reality in the near future. How many of you here this forenoon are aware of the fact, said to be true (I can't vouch for the figures in regard to matters on the other side because we do not know here as yet, and probably will not know until after the war is over), but it is said that to-day the personnel of the French air service numbers more officers and men than we have in our entire army, and that the personnel of the British air service to-day numbers more officers and men than we have in our entire

navy. There seems to be no doubt whatever but that in Germany there are from nine to ten thousand aeroplanes along the various battle fronts, and probably France has an equal number. England also has thousands, so it does not seem a very wild dream for those acquainted with the facts to imagine the time when this country will have at least two thousand aeroplanes along each of its coasts, ready for military emergency, but, pending that time, engaged in the study of our coasts and the waters off them; engaged in life-saving and perhaps the assisting of vessels in distress, and also carrying the mail. Carrying the mails is going to be one of the earliest developments of the aeroplane.

Now, just a quotation or two, to bring home to you the fact that what I have been telling you is based upon actual experience. I am going to quote to you, very briefly, the remarks of men over on the other side of the water; men who are of the highest grade of intelligence, bred to knowledge and vision; men who are in the very thick of the vital things which are happening over there; men on whose shoulders rest the safety and lives of their respective nations.

Mr. Balfour, on the floor of the House of Commons: "The time is here when command of the sea will be of no use to Great Britain without corresponding command of the air." Lord Charles Beresford, on the floor of the House of Lords: "The time is here when Great Britain's air service will be more vital to her existence than her army and her navy combined." Lord Montague: "Every first-class nation in the world immediately will be forced by that sheer necessity which knows no law, which recognizes no precedent, which fears no government, to have a separate independent department of aeronautics." General Pitame, one of the great defenders of Verdun, on the floor of the first Chamber of Deputies: "I see in the near future France with fifty thousand aeroplanes."

This matter of the aeronautical development of this country, ladies and gentlemen, has especial significance to me here to-day, in this particular place, because this coast patrol system which is moving forward and probably will become an actual fact, commenced when that system was launched in this very building, in the Mayor's office, a year ago; when the project was presented

to the Mayor of Portland, turned over by him to the Portland Chamber of Commerce, carried to a successful issue as regards the raising of funds for the establishment of one of these stations. The movement has crept along both of our coasts. Fourteen cities to-day have the funds ready to establish such stations. Some of them would have been established ere this had it not been that early last winter Senator Johnson of Maine introduced in the Senate a bill providing for an appropriation of a million and a half with which to establish that system around our entire coast, and, a week later, Representative Kearns of San Francisco introduced the same bill in the House of Representatives, and there is a practical certainty that that bill will be passed at the next session of Congress.

Believe me, gentlemen, there is to-day no more crucial question affecting both the military and the civil and commercial progress and position of the United States than a great independent department of aeronautics at Washington, to give us command of the air.

I thank you very much for your kindly attention.

PRESIDENT SULLIVAN. It is certainly interesting to know that this is the first anniversary of that history-making episode that occurred in this municipal building one year ago, and Admiral Peary certainly stated clearly and reminded us of that motto, "Safety first."

I wish to thank the Admiral, in behalf of the New England Water Works Association, for his presence here to-day. The meeting now stands adjourned.

[The meeting was then adjourned until 8 P.M.]

EVENING SESSION, WEDNESDAY, SEPTEMBER 13, 1916.

The meeting was called to order at 8.15 P.M., President Sullivan in the chair.

The Secretary read an application for membership from Mr. W. H. Williams, superintendent of public works, Braddock, Pa., which had been properly endorsed and approved by the Executive Committee. On motion, the Secretary was empowered to cast the ballot of the Association in favor of the candidate, and,

he having done so, he was declared by the President duly elected as a member of the Association.

Mr. David E. Moulton read a paper on "The Water Supply of Portland," which was illustrated by stereopticon slides.

Mr. Harvey D. Eaton read a paper on "The Extension of the Water District in Maine."

Mr. L. L. Wadsworth read a paper on "The Water Supply of Madison, Anson, and Emben." These papers were discussed by Mr. Fuller and Mr. McKenzie.

A paper by Mr. E. E. Lochridge, on "The Application of Coagulant Intermittently in Excess Amounts at Springfield, Mass.," was read by Mr. Hawley, in the absence of Mr. Lochridge.

Morning Session, Thursday, September 14, 1916.

The Secretary read the applications for membership of Patrick J. Mullen, Cambridge, Mass., and Perley J. Blake, Pepperell, Mass., both of which had been properly endorsed and approved by the Executive Committee.

On motion, the Secretary was empowered to cast the ballot of the Association in favor of the candidates, and, he having done so, they were declared by the President duly elected members of the Association.

President Sullivan. The membership is growing, and we have now a membership of considerably over a thousand, but the field is still broad, and we trust that some of our members will bring in their friends, engineers of pumping stations, general foremen, registrars, men who are interested in water-works problems generally, because we believe it will be of benefit not alone to them but to us.

We have with us this morning Mr. Cummings, secretary of the Bureau of Conventions, Portland Chamber of Commerce, and I will call upon Mr. Cummings for a few words.

Mr. Cummings. *Mr. President and Gentlemen,* — I was booked to speak to-morrow instead of to-day, but the plans having been rearranged, it brought me in this morning; something that might be called a detour.

There was a Portland youth of six or seven years who had been

out with his father and mother in an automobile, and heard something about a detour. He looked at his mother and said, "Mother, I know what a detour means." She said, "What does it mean?" He said, "It means mud." We will endeavor not to make the detour of this morning mean mud, because water men naturally keep away from mud, as far as possible.

It is not necessary for me to speak in behalf of the Chamber of Commerce any word in reference to our city, of which we are so proud, because you have seen it, and can judge for yourselves. As your President told you yesterday, Portland is the birthplace of the father of Maine's prohibitory liquor law, and, naturally, we, having been brought up on water and nurtured on it, want the real article. We are somewhat fussy about the quality of our water.

A few years ago I was secretary of the board of health, an office that went along with the city clerkship. The doctors on the board naturally did most of the board of health work. We closed Saturday noon, and about one o'clock one Saturday a fellow straggled in from one of the up-country towns and said that he was looking for the board of health. I said, "The board of health office is closed, but I am secretary of the board. Anything I can do for you?" He said, "Yes. Do you know, there is a dead man in Sebago Lake." I said I wasn't aware of the fact. He said, "Yes, there is." He gave me the name, and told me when he was drowned. As you know, we get our water from Sebago Lake, and naturally I was a little interested. He said, "I know where he is." I said, "If that is true, you are an interesting character. Where is he?" He went on to tell me in nautical terms that he was so many points north by northeast of a certain point, indicating that he knew what he was talking about, and he wanted to be employed to drag for the body. I said, "We will go down and see the water commissioners; they will be interested in this." He said, "I thought the board of health would." I said, "It is, but let us start with the water commissioners." He looked up and he said, "Wouldn't the Government be interested in this?" I said, "Just why do you think the Government might be interested in it?" He said, "Wouldn't that come under the pure food law?"

I was assigned to speak on Sebago Lake, but I am not going to give any formal talk on that subject or anything else, except in this general way. As we all know, we need the coöperation of the people and of the municipality in the affairs relating to public matters, particularly in reference to water works. We are especially fortunate in Portland in having our water plant under the control of a non-partisan commission. Portland is interested, and stands back of the commission, but it is not very keen on elections. Yesterday I ran through the city clerk's record, just to see how the comparative vote was on elections on trustees. First, in 1907, when the vote came whether the city should take over the water works, a two or three million dollar proposition, — and we had 14 000 voters, — only 3 499 came out. If it had been a question of whether or not we should have three ward constables instead of four, or who should be sheriff, I have no doubt we would have got out pretty nearly all of the 14 000.

In 1908 we voted for a water trustee. The act creating the water district provided that no other subject, or no other election, should be pulled off in connection with the water district election, but our City Hall had burned then, — the old hall on this site, — and there was quite a discussion as to whether we should rebuild on the old site, or over in Lincoln Park, and what kind of a building; whether it should contain an auditorium, and a number of such questions as that. It was suggested at the time that it be put to the voters. We could not attach it to the regular water district ballot, but there was no objection, of course, to our having a special expression of the people on that point. So we had a separate ballot box in every ward room, and, as the people came up to vote for the water district trustees, they also cast in their ballots expressing their preferences on the various topics relating to City Hall. We got out 5 761 voters at that time, but it was the City Hall matter that really brought them out.

In 1910, at the election of trustees, there were 2 986 votes cast; in 1912, 3 410; in 1913, 2 226, and in 1914, 3 266, showing that Portland has confidence in its trustees; otherwise they would come out in greater numbers when it came to the matter of election.

As an illustration of coöperation, we point to our municipal

organ in the City Hall, which you will be able to hear to-morrow noon. This building was in process of construction, and Adam P. Leighton, then mayor, was at the head of the City Hall Commission. Cyrus H. K. Curtis, publisher of the *Ladies' Home Journal*, Philadelphia, who was a native-born Portland man, was here on a visit, and called on Mayor Leighton. The Mayor was showing him over the city, and took him through City Hall. As they left, Mr. Curtis said, "I would like to do something for Portland, some day." Mr. Leighton, who had been a boyhood friend, said, "Perhaps I can show you the way." After Mr. Curtis had returned home, Mr. Leighton wrote him and suggested the introduction of a municipal organ in the City Hall. Mr. Curtis wrote back that the suggestion very much appealed to him, and asked Mr. Leighton to come to New York. He did so, they consulted the builders, and Mr. Curtis gave the organ, on which nearly sixty thousand dollars has been spent. That includes the echo organ, which is hidden in the ceiling. In the programs which we will probably be able to distribute to-morrow is the description of the organ. I think some of those were sent to you with a circular letter sent out by the Chamber of Commerce. That organ is the fourth largest in the world, and is said to be the best.

It was predicted by some that it would be a white elephant on the city's hands. The city went ahead and hired a municipal organist at a salary of $5 000 a year. This organist recently had occasion to respond to a toast, and he got up and declared himself as the only municipal organist in captivity. He is a wonder; he is worth every bit of his salary. He was drawing more than that when he came on from New York. He happens to be on his vacation now, but he has kindly consented to come to-morrow and give an hour's concert, beginning at half past one.

To-morrow morning, Mme. Eames, the great singer, is to be here for a rehearsal, in preparation for some concert she is to give. She has not tried out her voice with the Portland organ. Mr. MacFarlane is to have a rehearsal with her at quarter past twelve to-morrow, and he has asked me to say that there will be no objection to anybody being in there during the rehearsal, but they want absolute quiet, from quarter past twelve for a half hour,

during the rehearsal. The public concert, to which everybody is invited, including the ladies, will be from half past one to half past two to-morrow.

In behalf of the Chamber of Commerce, I wish to endorse what was said yesterday as to our pleasure at meeting you all, and if there is any way we can serve you during your stay in Portland or any other time that you come to see us, just call on the Chamber of Commerce.

PRESIDENT SULLIVAN. All desiring to visit Winslow & Company's sewer pipe works will leave the car station at the head of Elm Street at 11 A.M. to-day. It is a very interesting place to go, to view the manufacture of sewer pipe.

Mr. Taylor cordially invites all who are interested to visit the new storage plant, one of the largest and one of the best cold-storage plants in the country. He will meet any member who wishes to go and see the plant at 11.30 in front of City Hall. To-morrow afternoon there will be tea for the ladies, at Riverton. Special cars will leave at 3 P.M. to take them down and bring them back.

All those who wish to remain down for the evening's entertainment may do so, and I wish it to be known that the committee desire that all the ladies who are going there should signify their intention, so that the members may register, and it would be a great accommodation to the committee if all who intend to stay down for the dinner, or go down for dinner to-morrow night at Riverton, would register at the Secretary's office.

[Mr. W. S. Johnson read the preliminary report of the Committee on Service Pipes, which was discussed by Messrs. Fitz-Gerald, Heffernan, Hawley, Fuller, Hastings, Martin, McKenzie, Sawyer, Dolan, Speller, Aston, Taylor, Agnew, and Weston.]

EVENING SESSION, THURSDAY, SEPTEMBER 14, 1916.

The Secretary read the application for membership of Alfred M. Chaffee, president and general manager, Oxford, Mass., which had been properly endorsed and approved by the Executive Committee. On motion, the Secretary was empowered to cast the ballot of the Association in favor of the candidate, and, he

having done so, he was declared by the President duly elected a member of the Association.

THE CHAIRMAN. The discussion on service pipes will be continued this evening, but on account of the other papers that are scheduled for this evening, and into which this discussion breaks, the total discussion on the service-pipe question will be limited to one-half hour, and individual members discussing the paper will be limited to five minutes, and will be cut off at that time.

The discussion on service pipe was resumed, being participated in by Messrs. Aston, Speller, Gear, Martin, and Raymond.

It was voted to adjourn the discussion to a later meeting.

Mr. Frank A. Barbour read a paper on "Leakage from Pipe Joints," and on motion of Mr. Sherman it was voted that Mr. Barbour's paper should be printed in the same form as the advance copies of the papers to be read at this convention, and sent to each member of the Association.

Mr. S. E. Killam, superintendent pipe lines and reservoirs, Metropolitan Water Works, Boston, Mass., read a paper entitled, "Breaks in Main Pipes," which was discussed by Mr. FitzGerald, Mr. Atwood, and Mr. Fuller.

Mr. George H. Finneran, general foreman, Water Service, Boston, Mass., read a paper on "Emergency Trucks and Repair Gangs."

FRIDAY MORNING, SEPTEMBER 15, 1916.

The meeting was called to order at 9.15. President Sullivan in the chair.

PRESIDENT SULLIVAN. Mr. Cummings, of the Portland Chamber of Commerce, is here.

MR. CUMMINGS. I have two announcements to make. One is that we would like to know as soon as we can this afternoon how many are planning to go back to New York at 8.40 to-morrow night. The Maine Central and the Boston & Maine Railroad have arranged so that they can take care of just as many as need to go, only they would like to know in advance how many there will be who need reservations. They have already put on one car, and they will put on as many more as are needed.

The other thing is, that I want to remind you again of the organ concert at 1.30 to-day. The city organist is on his vacation, but we have arranged for him to come and give a concert from 1.30 to 2.30. You are invited to come and bring the ladies.

Mme. Eames is to try out her voice with the piano and with the organ, in preparation for a concert. It is not in the nature of a recital at all; it is simply a try-out of her voice. There will be no objection to the members and the ladies being present. The only request is that there shall be absolute quiet from 12.15 on for the matter of a half hour. That will be during the lunch hour of a great many, and I suppose that is why it was selected, to make sure it will be quiet, but to the concert from 1.30 to 2.30 everybody is invited, and the more there are there the merrier.

PRESIDENT SULLIVAN. I am going to call on General Manager Graham, of the Portland Water District. I suppose you have seen him about, you all know him by this time, and you have noticed with what smoothness and efficiency everything has been running along here in Portland. He desires to make an announcement.

MR. GRAHAM. I simply want to take up a moment in regard to the entertainment. The Portland Water District automobile is at the disposal of the ladies all day. Make up a party of six, and, if you find it there, just use it. The chauffeur has been given instructions to take parties out for half or three-quarters of an hour. So keep him busy.

After the organ recital, Mr. Vernon West would like to meet the ladies who are going to Riverton, at the car waiting-station in Monument Square. A special car will be there to take them to Riverton. This evening we would like to have all the gentlemen go out there to get their dinners, and the entertainment will begin at eight o'clock. Now, don't let the weather keep you away. It looks a bit showery this morning, but should it become rainy the exercises will take place in the ball room, so that we will be all right, rain or shine. If it is pleasant, we will go out in the open-air theater. I would like you all to go out. It takes about half an hour to get there. Take any car marked "Riverton Park," down at Monument Square. The cars run every fifteen minutes.

PRESIDENT SULLIVAN. I wish to announce that immediately following this meeting there will be a meeting of the Executive Committee. I am going to call upon Mr. Sherman as a member of the committee on "Grading Water Works with Reference to Fire Protection."

The report of the committee was read by Mr. Sherman, and was discussed by Messrs. Booth, Thomas, Fuller, Hawley, Coggeshall, Macksey, and Wigmore.

Mr. A. L. Sawyer read a paper on "Some Advantages of a Classified Cash Book."

Mr. E. L. Pride, certified public accountant, read a paper on "Water-Works Accounting," which was discussed by Mr. Schwabe, Mr. McKenzie, Mr. Hawley, Mr. King, Mr. Sherman, Mr. Fuller, and Mr. Bacon.

It was moved by Mr. Sawyer that a committee on accounting be appointed. An amendment was offered by Mr. Baker that the committee should take into account the investigations made by other water-works associations. Mr. Sawyer accepted the amendment, and the motion as amended was carried.

The President subsequently appointed the following committee: Albert L. Sawyer, Haverhill, Mass., chairman; Walter P. Schwabe, Thompsonville, Conn.; Samuel H. McKenzie, Southington, Conn.; E. D. Pride, Boston, Mass.; A. R. Hathaway, Springfield, Mass.

The President announced that he had a number of invitations from different cities for the next annual convention.

PRESIDENT SULLIVAN. I shall not read these letters entirely, only go over them rapidly. Springfield, Mass., sends a cordial invitation for us to go to Springfield; the New Haven Chamber of Commerce; the Business Men's Association of Saratoga Springs, through its secretary, sends a cordial invitation; the Providence Chamber of Commerce, through its convention committee and president, sends us a cordial invitation. I have from the Holyoke Water Department a very urgent invitation supplemented by a telegram from the president of the Chamber of Commerce and the mayor.

MR. MCLEAN. In behalf of the City Government of Holyoke and the Board of Water Commissioners, I wish to say just a word and give you a hearty invitation to hold your convention next

year in Holyoke. You held your convention before in Holyoke, and it gave us great pleasure to entertain you to the best of our ability. Holyoke is young, growing, and what we call a model American city, with a modern water service, — we think one of the best; and a modern fire department, with modern fire houses, which we think is equal to the best; and a gas and electric department owned and controlled by the city of Holyoke, which we think is of the best. We heartily invite you to come to Holyoke next year. We have a new modern hotel that cost close to a million dollars, which is equal to accommodating all the guests and members that may come.

Holyoke is admirably situated on the Connecticut River, about halfway between here and New York, about a hundred miles from New York; very centrally located. It is a very pleasant spot, one of the garden cities of New England; near the institutions of learning of Amherst and Smith, and Mt. Holyoke is just across the river. They are great seats of learning, and at our feet is that beautiful Mt. Tom, where visitors and friends can go around and see the beautiful scenery, the charm of the Connecticut Valley. I heartily invite you, in behalf of my colleagues, our superintendent and engineers and friends, fifteen in number, who are here to attend this convention, from Holyoke, and who always come in such numbers. We always attend your conventions, and take great interest in your affairs, and we wish by our presence and our numbers to do what we can to help make the convention a success. In behalf of the mayor and my colleagues, we heartily invite you, and trust you will see your way clear to honor Holyoke by your presence next year.

President Sullivan. We heartily appreciate your kind invitation, but under the constitution the matter will be referred to the Executive Committee for action.

Mr. Gear. Upon any subject that Mr. McLean takes up, there isn't much left for anybody else to say, because he covers the ground so well. From the reception we have got here, it is plain to all of us that a city of 65 000 people can entertain us as well as New York or Boston or Philadelphia. I had a different idea of Portland before I came here. I am glad I came. I thought Portland was one of these old cities that was incorporated

about a hundred years ago; never moved very fast. I came here and found it was a " live wire " city. That is what we have got in Holyoke, a population of 65 000, and we will entertain you; everybody in Holyoke will be at the gateway to meet you. Mr. Martin will be down in Springfield to show you the way up. You can go to the top of Mt. Tom; we will take you up on one of the best street railways of the country. You can see Springfield, Hartford, and New Haven. You don't have to go there at all; you can see them from Holyoke. Lots of you gentlemen will have a few daughters at Smith College, which is only eight miles from Holyoke. You will want to go and see the place where they will spend the next four years in college. It will be a lovely time to go there. Across the river is Mt. Holyoke. There are about seventeen hundred girls there, and about a thousand in Smith College. You can go and smile at them. At Amherst College your boys will be learning agriculture, and there is another college where they go, besides the agricultural college.

People who have traveled all over the world, up the Hudson and through Switzerland, go on the top of Mt. Tom and say that is the most beautiful spot they have ever laid eyes on. That is what we will show you. We will show you something else. If you want to come by railroad into Holyoke, we can bring you on a steam railroad that is owned by the city of Holyoke, the only city in the United States that owns a steam railroad of its own. We have seven miles of railroad, and that belongs to the city of Holyoke — leased, of course, to the New Haven. They pay us 14 per cent. forever on it, so we don't kick. That's the way we are fixed in Holyoke. Every automobile in Holyoke will be at your command while you are there. Any time you want to go, we will take you; we will guide you around one of the nicest water-works spots of its size in the country, and we can show you the cheapest water and the best drinking water. You can drink all you want of it, and they have other stuff to drink in Holyoke, too.

PRESIDENT SULLIVAN. I trust all the members will be here at the afternoon session, so we may close up the business of the convention.

[The morning session then adjourned.]

AFTERNOON SESSION, FRIDAY, SEPTEMBER 15, 1916.

The meeting was called to order at 3.10 P.M., President Sullivan in the chair.

A paper entitled, "A Suggestion that the Association Appoint a Committee to Prepare Standard Specifications for Water Meters" was read by Mr. R. J. Thomas, and was discussed by Messrs. King, Brown, and Brewer.

PRESIDENT SULLIVAN. Within a few years, different states have been creating commissions, utility commissions, and public-service commissions for regulating utilities. At first the utilities looked askance at the creation of these bodies, but I can say from what I know and what I hear from others that the companies now consider it a boon, because the commissions usually are fair and just. While they may have been created to look after the welfare of all the people, they also look out for the welfare of the utilities, in their fairness and their justice, and they give a square deal to the companies. It is our honor and our privilege to have with us to-day the chairman of the Maine Utilities Commission, Judge Cleaves.

JUDGE CLEAVES. *Mr. President and Gentlemen of the Convention*, — I want in the beginning to express my appreciation of the privilege of being here to-day, and my regret that I was unable to attend the meetings which took place yesterday and the day before. During the few minutes that you will have to bear with me, I apprehend you won't be surprised if I refrain from undertaking in any way to touch upon any of the technical, managerial, organization, or engineering features which you men are so familiar with, and concerning which I have not even a superficial knowledge. What I say to you will be along very broad lines, along the line which the President in his introduction suggested.

Between the three groups which in every New England state now are dealing not only with the commodity which you have to sell, but all other public utility commodities, a partnership exists, consisting of three members, the public, the utility, and the utility commission; and, the sooner the different members of the public and the remaining few members who are superintendents or managers of the public utilities become fully convinced of that fact, the better results will be obtained for us all. The utility commission,

or public service commission, was not intended and was not created for the sole purpose of carrying on and carrying out what was by some and at one time considered the sole benefit of the public, by reducing rates, requiring additional service, and in various ways hammering and pounding the public utilities. One of the prime objects, I believe, at the end of nearly two years' experience, and one of the fine things which the law will bring about, will be a much better understanding between your customers and you; and the public utility commission can assist, and is assisting, in gradually bringing about that better understanding. If a complaint, whether formal or informal, be made to a fairly well-informed public-service commission, the members of that commission, if they are honorable and just, feel it a duty to sit down and explain to the complainants, if they are wrong, wherein they are wrong. An individual who occupies a public position like that, to my mind, can do much more toward placating a man, or a group of men, who think they have grievances, than can the interested superintendent or manager of the particular utility which that complainant wishes to curse and swear about. So I believe that one of the principal and important functions of the public service commission, not only in New England but elsewhere, is to stand in an explanatory, fair, and decent attitude, as a sort of a bumper, not only between a group of complainants who have no real grievance, and the public utility or public service corporation which otherwise would receive first condemnation, but when, as has been the case in this state, and I assume it has been the case in other states, a special drive is attempted by some uninformed legislator against some particular public utility corporation, or some particular class of public utility corporations.

The legislature perhaps intends to do what is fair and right but, through misinformation or lack of information, may not be in a position where they can do anything that is beneficial either to the public or to the public service company. The moment that a legislature or commission does anything which unfairly and materially injures any public service company, that legislature or that commission has done something which injures the entire state in which the action takes place. That, offhand, is my belief, as a result of a somewhat brief experience.

I do not know how the matter of which I am to speak may affect all New England. I know it does not affect Massachusetts, because I take Massachusetts as sort of a test in this very brief but very important recommendation. I know that it affects the state of Maine, and I should imagine it would some of the other New England states. This organization which you have, and which embraces all New England, is splendid, but the state of Maine ought to have a separate organization, consisting of the managers and all others who are interested in a managerial capacity with our water companies. The big fellows don't need it. Take your Portland Water District here; well officered, well manned, well managed; in charge of men who are scientists in their line, who need no suggestion, no help, no encouragement. But those men cannot stop in the performance of their public duty, and in their duty as citizens, by saying "We are sufficient to ourselves; we don't need help, hence we won't help anybody else." There ought to be, and in my judgment for the success of the smaller water companies in the state of Maine must be, a state association having somewhat frequent meetings, where there can come under discussion the problems of the little fellows; the men or group of men who are perhaps running a water company which is supplying one, two, or three communities, where the aggregate of their takers may be five or six hundred consumers; five or six hundred different services. Those are the fellows that need help, and those are the communities that need help. Now, why do the communities of which I speak in the state of Maine need that kind of assistance which can come by a larger and fuller information of our managers? They need it simply because their managers get more or less discouraged, on account of the things that come up in their everyday life, their everyday business, which they don't actually know how to surmount.

It may be said that there are two ways that the law provides, in which any water company may absolutely protect and fortify its sources of supply. One is because the state gives every water company the right of eminent domain, which, of course you all understand, is the right to go out, and so far as it is necessary for the protection of the watersheds, condemn land, under certain

legal proceedings; but you have to pay for it. They don't give it to you. You have to pay them money for it. We have a law, it may be said, that makes it a penal offense for any person to knowingly or willfully pollute any pond or stream or source of supply. I sat for a good many years as a magistrate in one of the police courts in the state, and if any of you gentlemen happen to be lawyers you know how easy it would be for a good attorney to show absolutely to a court, and particularly to a jury of the county, that the ordinary pollution was neither done knowingly or willfully, because there is a vast difference, legally, between an act done knowingly and willfully and the same act, having the same result, done heedlessly or carelessly. But the pollution which goes into your water supply, and through your water system to the consumer; the pollution which comes from heedlessness and carelessness, is just as dangerous as though it was the result of a knowing or willful malperformance.

Now, in Massachusetts, the legislature has not only enacted a law, making it an offense to knowingly and willfully pollute a water supply, but it has placed in the hands of the State Department of Health very large, very important, and, to my mind, very necessary powers. The statute is as follows:

"The State Board of Health shall have the general oversight and care of all inland waters and of all streams and ponds used by any city, town or public institution or by any water or ice company in this Commonwealth as sources of water supply. The board may make rules and regulations to prevent the pollution and to secure sanitary protection of all such waters as are used as sources of water supply."

No water company or sewage company can secure legislative authority to build its system until it has secured the recommendation of the board as to the best method of protecting the existing or probable future water supplies. For us in the state of Maine, you can see how all-important that particular feature of the Massachusetts law is, that before a sewer company or a municipality, I assume, — it should be made as broad as that, — can plan and establish and put in use any sewer system, it must have the recommendation to the legislature of this board of health, or whatever particular board in the state of Maine might take

the place of that, and before the company can put in its water system, it must have the recommendation of that same authority, in order to protect not only the present and existing takers of water, but to safeguard the future. And, further:

"On petition to said board by the mayor of a city or the selectmen of a town or the president of a water company, stating that manure, excrement, garbage, sewage or any other matter pollutes or tends to pollute the waters of any stream, pond, spring or water course used by such city, town, institution or company as a source of water supply, the board shall appoint a time and place within the county where the nuisance or pollution is alleged to exist for a hearing, and after notice thereof to parties interested, and a hearing, if in its judgment the public health requires, shall by an order served upon the party causing or committing such pollution, prohibit the deposit, keeping or discharge of any such cause of pollution, and shall order him to desist therefrom, and to remove such cause of pollution."

We have had during the last year several complaints from parties against three or four and perhaps half a dozen different small water companies in the state of Maine, wherein it was alleged, and amply proven, that the supply of water that that particular company was putting into its mains and serving to the public was absolutely unfit for domestic use, and in nearly every one of these instances the company has very frankly admitted that the water being served was unfit for domestic use. It should be in every legislative charter, and if it is not in the charter, it is the duty of the water company as a matter of common decency to furnish pure water for domestic use. That is what you are for. The reason why you group together and serve the public with water instead of each man having a well is to give service. It is your duty to give good service. One of the elements of good service is serving a water that is fit for domestic use.

Some of the managers came to us and said, "What are we going to do?" I have in mind one particular instance where the municipality that was complaining through its board of selectmen as to the quality of the water, had a slaughter house within three hundred feet of the intake pipe; and not more than a thousand feet above the intake pipe of the unfiltered water there was a lumberman's camp that was used for all the things that such

a camp would be used for; and hog pens, private toilets, and all that sort of thing were being permitted by that local board of health, and still they were coming down and complaining as to the quality of the water.

In another instance, there was a stream that would have been a perfectly good stream of water, would have been all right for domestic use, had it not been for the fact that a town six or eight miles above dumped every particle of its sewage and garbage into it — a comparatively short distance above the place where the water takers of this other community were having it, unfiltered, turned into their mains and used. Well might the manager of the company say, " Yes, our water is unfit for domestic use, but for heaven's sake, what are we going to do? "

Going back to the right of eminent domain, that water company, or any of these water companies, might condemn and by paying for the land take the land adjoining the stream or the pond or whatever it is, but you who are serving some of our small country communities, way up in Maine, or Massachusetts, or anywhere else know how impossible it would be for a company whose revenue is limited, whose opportunity to broaden out is extremely limited, to pay for the watershed for that town or city of a somewhat large river, or even a substantial pond.

There are a lot of people, and I have heard some managers of water companies say, " This water analyzes all right. There is nothing absolutely dangerous to health in this water. There are no colon bacilli in it. There is nothing that would kill anybody." Somehow, I am so constituted, and I apprehend there are a good many thousand others in the state of Maine who are constituted so, that if I can go to a place where the water that I am drinking in my house comes from, and I see a hog pen, or a horse manure pile, or a garbage pile, or anything that looks like uncleanliness, I don't care whether there are three million colon bacilli to the tablespoonful of water, or whether there isn't a single one. I don't like the idea of having served to me for domestic use water that consists largely or partly of substances which drain from those places, and I apprehend the average citizen feels a good deal the same way. That is why Massachusetts — I don't know about the other states in New England — has

passed that law from which I quoted, and in which they not only refer to manure and excrement, but they speak of garbage, and all sources of pollution which in any way injure the public health.

I believe that in the state of Maine it is going to be — no, it is; the time has arrived; the clock has struck; there isn't any going to be; it is now; it is this legislature, this year, when you have got to have, not the law of eminent domain, which you can't use; not a law that says that whoever " willfully or corruptly " pollutes the source of supply of a water company, which doesn't amount to anything, but you have got to have some law, giving authority to some board, so that it or its representative can go to a place where a bad condition exists, and if it seems reasonable that that corporation or that man or that municipality or whoever it may be is needlessly maintaining something which is dangerous to health or obnoxious to the senses of the average human being, either near or within a stream which is supplying other human beings with water, the board can make the individual or the corporation remove that source of pollution and desist from future accumulation.

Somebody may ask, " Who is going to pay for this? " " The poor people are going to pay for it, and it is awful." The state will take hold of it. In Massachusetts the statute provides that an individual may be paid, if that which is necessary actually deprives him of the use of his land; the individual shall be paid, and paid by the state. The state of Maine is taxing all the people to build roads for some of the people. Under the referendum which we have recently enacted, the state is going to tax all the people to help some of the people build bridges. Almost every legislature which has met within my recollection (and it goes back further than I care to admit) has passed some special act to aid financially — and that money comes from all the people — to aid financially some small town whose bridge has been swept away by flood when the resources of the town were such, and crippled to such an extent, that it was impossible for it to build or rebuild that bridge. Now, is it any more important that all the people should aid in the building of roads; all the people should aid in the care of the insane and the poor and the mentally defective, which we are doing; in the building of bridges on a large scale, or

in the individual case of towns, than it is to take hold of this tremendously important proposition of protecting the health of all the public by aiding those companies which cannot afford to get control of watersheds by the right of eminent domain, and to give to the water takers, the people of our state, that which it is our duty to give, namely, pure water? If there is anything on the face of the earth within reason that the Public Utility Commission of the State of Maine can do to aid and assist in the passage of such a law as that, for which we feel there is the necessity, I say to you that we have the disposition to help you.

PRESIDENT SULLIVAN. You have heard the able address of the chairman of the Public Utility Commission. We agree with all his remarks but one, and that is that the "State of Maine ought to have a separate organization." We as members of the New England Water Works Association do not believe it is necessary. More effective and better results can be obtained by our larger organization. The membership of the New England Water Works Association is broader than New England. It has no Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, or Connecticut. In this day of merger and combination, some of us, at least, believe there can be better and more effective work done in an Association of this kind by having all the states represented, not alone the New England States, but the United States, Canada, and I might say the world. We have members from foreign countries. It is by numbers we are enabled to get this splendid and full rounded organization. We are able to maintain permanent headquarters. We are able to get a broad exchange of ideas, not alone from New England, but from the world, and these members from the smaller communities may join the New England Water Works Association and thus get the advantage of association with experts and water-works men of experience and men working along kindred lines.

We want the water-works men from the state of Maine to join us. We want their knowledge and their experience. We want to keep those we already have, and after this successful convention here in Portland, do you suppose we are going to allow a divorce? No, sir, not even the slightest disagreement or separation. To-day we are banded and bonded together stronger than we ever

were before, and we intend to hold tight on to every member from Maine. It may be, as time goes on, we should have a chapter or branch here in Maine. I wish to good-naturedly warn every one here that if anybody undertakes to separate the New England Water Works Association from our members "down East," there will be a real old-fashioned campaign such as this state witnessed lately and which ended last Monday. Well, I am not going to say any more about campaigns. It might be loaded. It is dangerously near politics, and we are not in politics.

However, ours is a broad line of usefulness, and we are going to hold on to our veteran member, Mr. Burnie, and others. Do you suppose we are going to lose Mr. Graham after the splendid work he has done for us, — after he has shown us what Portland is and what Portland can do, — the man who greased the ways for the New England Water Works Association to sail on Casco Bay?

It was a Portland man who wrote:

> "Thou, too, sail on, O ship of state!
> Sail on, O Union, strong and great!
> Sail on, nor fear to breast the sea!
> Our hearts, our hopes, are all with thee.
> Our hearts, our hopes, our prayers, our tears,
> Our faith triumphant o'er our fears,
> Are all with thee, — are all with thee!" — the state of Maine.

I wish to say again, we intend to retain our members from Maine and get new ones. I sincerely believe it is of mutual advantage to our Association and the water-works interests of Maine to remain together.

Mr. Cleaves. If you give me just a moment of explanation. I surely did not mean to be understood as advocating that the water men of the state of Maine should form a separate and independent association, and not amalgamate with this splendid union, but I feel perhaps the state of Maine needs what some of us more religious ones do. We want to go to church on Sunday for the bright and nice religious things, but occasionally through the week we need to go to prayer meeting. I think the state of Maine needs a few prayer meetings.

President Sullivan. That is right, your Honor, but our

Association would like very much if the water-works men of Maine would take their religion from us.

On behalf of the New England Water Works Association, I sincerely thank Judge Cleaves for his presence and for his able address. He has reminded us that there is a fertile field for our Association in Maine, and that we must carry the gospel of water-works unity to some of our brethren down here. We must tell them about our excellent JOURNAL which publishes our transactions, papers, and addresses, and that every member receives the JOURNAL regularly; that in the small communities in the state of Maine where the water-works managers are unable to get to out Boston meetings, or even where they are unable to get to a Portland meeting, if they should join with us they would get our literature which has a fund of useful information which would be invaluable to them. I would most respectfully suggest to our honored guest that, as chairman of the Public Utilities Commission, he might do us a favor and a favor to the water-works fraternity of Maine by gently reminding the water companies that it would be a good business for some of their employees or managers to become affiliated with the New England Water Works Association and thereby keep in touch with the water-works world through our JOURNAL, which is a veritable storehouse of useful knowledge.

We have another important thing before us now, and that is, "Some Problems of New Hampshire Water Supply Sanitation," by C. D. Howard, chemist, State Board of Health of New Hampshire. I call upon Mr. Howard. After that we will have some more business, and I would like the members to remain until we get through.

[Mr. C. D. Howard read a paper, with the title as above stated.]

PRESIDENT SULLIVAN. It might be of interest to some of our members to know how our late revered associate, Mr. Walker, of Manchester, N. H., overcame some of the unsanitary surroundings on his watershed. Conditions were bad in spots on Lake Massabesic. He endeavored to have them cleaned up by suasion. Nothing doing by the owners of cottages on the islands. You know what a strong character Mr. Walker was. Well, he thought first of the health of the community, and as the owners of cottages

would neither "fish or cut bait," and as there was not sufficient law at the time to reach and correct these nuisances, he took the law into his own hands and, for the welfare of the community, he applied the torch to camps and cottages that were a menace to public health and said: "Get redress from the city of Manchester." The city settled and settled well. It was a good job well done. That is the way an unsanitary exigency was met and overcome in New Hampshire.

MR. C. W. SHERMAN. The Association is now ready to attend to its formal business, and I would like to submit a resolution of appreciation of the courtesies which have been tendered to this convention. It is, of course, a pleasure to express the sentiments of the convention as far as I can, after the generous and wholehearted manner in which we have been entertained. Nevertheless I cannot help wishing that some more eloquent member had been selected for this duty, particularly in view of the excellent character of the convention, and of the arrangements in every particular. I doubt, really, if we have a man in the Association who is ready to do justice to the theme. If you will pardon me, I will make a few preliminary remarks before submitting the formal resolution. In the first place, I want in these informal remarks to say a few things that it is hardly proper to include in a vote of thanks, since they relate to our own members, Mr. Graham and Mr. Johnson in particular, who have so ably handled this convention. I have had a little experience with work of this kind, and I know what it means to do it. Probably most of the members can do a little guessing, and perhaps if they doubled what they guessed they would not be far out of the way. It is a great pleasure to me to testify, from my knowledge of how previous conventions have been run, to the excellence of this one. The figures of attendance, of course, speak for themselves. The general attendance at the sessions of the convention speaks for the interest of the members in the sessions, and perhaps in particular also for the wisdom of selecting a place where there are not too many outside diversions or distractions. As Mr. Gear remarked this morning, it is a satisfaction to demonstrate that it is not necessary to hold conventions in Boston and NewYork in order to have them successful and well attended. As far as I

know, the only unfortunate and regrettable event in our convention is the accident to one of the automobiles on the return yesterday afternoon, when Mrs. Blake suffered a severe injury. Of course I speak the sentiment of the entire convention when I say that we regret that extremely, and I should like very much if Mr. Graham could telephone or in some other way express in our behalf to Mr. Blake and Mrs. Blake sympathy with them for the accident.

The resolution as I have written it out is as follows:

Resolved, that the thanks of the Association are hereby extended to his Honor Mayor Chapman and to the city government of Portland, for the use of the City Hall and for the many other courtesies which they have extended; to the trustees and other officers of the Portland Water District; to the Portland Chamber of Commerce; to the municipal organist, Mr. Will C. Macfarlane; to Judge Cleaves; to Admiral Robert E. Peary; to the citizens of Portland who have loaned automobiles and in other ways helped to make the convention a success; to Hiram Ricker & Son, proprietors of Poland Springs; to the Portland Stoneware Company and the New England Cold Storage Company, who extended to the convention the privilege of visiting their plant; and to the other friends and individuals who have extended so many courtesies to the Association.

PRESIDENT SULLIVAN. Before we take a vote on these resolutions, I wish to ask Mr. Graham if he will kindly convey to Mr. Blake, president of the Portland Water District trustees, our sincere regrets because of the automobile accident, and trust that Mrs. Blake will have a speedy recovery to good health.

MR. GRAHAM. I will do that, Mr. President.

PRESIDENT SULLIVAN. You have heard the resolution. We have certainly had a fine convention in Portland, and the Portland people have lived up to the reputation they have always had in the past. I ask all in favor of this resolution to rise.

The resolution was passed by a unanimous vote.

The Secretary read the application of Alfred M. Chaffee, Oxford, Mass., for membership, which had been properly endorsed and approved by the Executive Committee. On motion, the Secretary was empowered to cast the ballot of the Association

in favor of the candidate, and, he having done so, he was declared by the President duly elected a member of the Association.

THE PRESIDENT. There will be meetings of the Executive Committee and of the convention committee just as soon as we can get together. I trust all the members will go to Riverton Park for the final event of the convention. To-morrow, of course, some will go to the mountains, and some may not come back to Portland. However, I wish all the members in town would go out to Riverton to-night and see what Mr. Graham and our friends in Portland have done for us.

MR. GRAHAM. I would like to say a word in connection with the Riverton affair. I know the boys will be very much disappointed unless they have a good audience to-night. I trust every member who can will go there. The boys will appreciate it.

PRESIDENT SULLIVAN. A final word from Mr. Johnson before we ring down the curtain.

MR. JOHNSON. Mr. President, I don't know as I have anything to say. I have one great big feeling of gratitude all through this convention, to think how smoothly the Portland members of the committee made the thing run. I have had nothing to do but sit around and see the wheels go round. The Portland people have done it all in the very best possible way, and I am only proud that I was chairman of this committee during this convention.

The convention then adjourned.

REPORT OF COMMITTEE ON EXHIBITS, THIRTY-FIFTH ANNUAL CONVENTION.

To the President, Members, and Associates of the New England Water Works Association:

As chairman of the Committee on Exhibits for the Thirty-Fifth Annual Convention, I was fortunate in having Messrs. Harris, Thorne, and Newhall, of the Portland Water District, serve with me, and during the progress of our work had many occasions to congratulate myself on this choice.

Our first duty was to secure a satisfactory room for the exhibits, and, as the convention was to be held in the new Municipal

Building, we at once selected the main auditorium, which we obtained the use of without charge for rent or light through the efforts of the Portland Water District and the kindness of Mayor Wilford G. Chapman. Electricity for power was donated by the Cumberland County Electric Company.

Having ample room at our disposal, we next solicited exhibits, and our effort in this direction was so successful from the start that we felt justified in making somewhat extensive arrangements for the comfort and convenience of our exhibitors and the delegates who would visit them.

Our time for building and decorating the exhibitors' booths and getting the exhibits in place was very limited, but everything was ready as planned, and at five o'clock Tuesday afternoon the exhibit hall was opened to the delegates.

We did not award gold medals, but the officers, committee, and delegates decided unanimously that the following are entitled to honorable mention:

Addressograph Company, *The American City*, American Manganese Bronze Company, W. L. Blake & Company, Harold L. Bond Company, Builders Iron Foundry, A. M. Byers Company, Carbic Manufacturing Company, Central Foundry Company, The Chapman Valve Manufacturing Company, Chicago Pneumatic Tool Company, Wm. R. Conard, Cumberland County Electric Company, Joseph Dixon Crucible Company, Eddy Valve Company, Electro Bleaching Gas Company, *Engineering News*, *Engineering Record*, *Engineering and Contracting*, *Fire and Water Engineering*, Ford Meter Box Company, The Garlock Packing Company, C. Godfrey, The Goulds Manufacturing Company, The Hartford Contractors' Supply Company, Hays Manufacturing Company, James Hermeston Manufacturing Company, Hersey Manufacturing Company, The Leadite Company, Lead-Lined Iron Pipe Company, Ludlow Valve Manufacturing Company, MacBee Cement Lined Pipe Company, H. Mueller Manufacturing Company, Multiplex Manufacturing Company, National Meter Company, National Tube Company, National Water Main Cleaning Company, Neptune Meter Company, The Pitometer Company, Pittsburg Meter Company, Portland Gas Light Company, Power Equipment Company, Rensselaer Valve Company, Ross Valve Manufacturing Company, S. E. T. Valve and Hydrant Company, Simplex Valve and Meter Company, The A. P. Smith Manufacturing Company, Smith & Abbott Company, Standard Cast Iron Pipe and Foundry Company, W. P. Taylor Company, Thomson Meter Company, Union Water Meter Company, United Brass Manufacturing Company, United States Cast-Iron Pipe and Foundry Company, Warren Foundry and Machine Com-

pany, Wallace & Tiernan Company, Inc., Water Works Equipment Company, R. D. Wood & Company, Worthington Pump and Machinery Corporation, — a total of sixty exhibitors.

The committee spent $780 in carrying on their work, all of which has been collected from the exhibitors, and there are no outstanding bills against us. In addition to the money spent by the committee, we estimate that the exhibitors' total expense was about $20 000, for representatives' time, fares, expenses, freight on exhibits, etc.; this does not include the value of exhibits, which amounted to at least $50 000.

We call your attention to these figures, as you will recall that the convention program covered something of importance from early morning until late in the evening, on each of the three days of the convention, and absolutely no time was set aside for inspection of exhibits. The delegates were anxious to inspect the exhibits, and, as the exhibitors had the best men on their sales forces on hand to meet them, we feel that the Association should set aside at least a day or two, at future conventions, for this purpose, if the exhibits are to be continued as a part of the convention.

In concluding, I wish to thank the exhibitors, whose combined efforts resulted in one of the largest and finest displays of waterworks goods ever made; my associates on the Exhibit Committee, without whose valuable assistance my task would have been impossible; Mr. Fred M. Prescott, the contractor for the booths and decorations, who did more for us than his contract called for; and last but not least, the employees of the Portland Water District, who did the assembling and arranging of exhibits.

Wm. F. Woodburn, *Chairman.*

November Meeting.

Hotel Brunswick, Boston, Mass.,
November 8, 1916.

The President, Mr. William F. Sullivan, in the chair.
The following members and guests were present:

Honorary Members.

R. C. P. Coggeshall. A. S. Glover. F. E. Hall.
R. J. Thomas. — 4.

Members.

D. L. Agnew.	D. A. Heffernan.	H. E. Perry.
S. A. Agnew.	C. R. Hildred.	H. G. Pillsbury.
L. M. Bancroft.	J. L. Howard.	P. R. Sanders.
F. A. Barbour.	A. C. Howes.	C. M. Saville.
G. W. Batchelder.	S. A. Holton.	A. L. Sawyer.
A. E. Blackmer.	W. F. Hunt.	J. E. Sheldon.
J. W. Blackmer.	W. F. Howland.	C. W. Sherman.
James Burnie.	W. S. Johnson.	E. C. Sherman.
George Cassell.	Willard Kent.	Sidney Smith.
J. E. Conley.	S. E. Killam.	G. H. Snell.
J. H. Cook.	G. A. King.	G. A. Stowers.
John Cullen.	John Knickerbacker.	W. F. Sullivan.
L. R. Dunn.	W. J. Lumbert.	J. L. Tighe.
F. L. Fuller.	P. J. Lucey.	E. J. Titcomb.
Patrick Gear.	H. V. Macksey.	D. N. Tower.
F. J. Gifford.	A. E. Martin.	W. H. Vaughn.
H. J. Goodale.	W. E. Maybury.	R. S. Weston.
C. R. Gow.	John Mayo.	H. L. Whitney.
J. W. Braham.	F. E. Merrill.	F. B. Wilkins.
F. M. Griswold.	M. L. Miller.	G. E. Winslow.
R. K. Hale.	William Naylor.	M. B. Wright.
A. R. Hathaway.	C. E. Peirce.	L. C. Wright.
Allen Hazen.	T. A. Peirce.	C. R. Preston. — 69.

Associates.

Harold L. Bond Co., F. M. Bates, G. S. Hedge.
Builders Iron Foundry, F. N. Connet, A. B. Coulters.
Darling Pump & Mfg. Co. (Limited), H. A. Snyder.
Chicago Pneumatic Tool Co., T. S. Eggleston, Jr.
Engineering News, N. C. Rockwood.
Hayes Machinery Co., F. H. Hayes.
Hersey Mfg. Co., A. S. Glover, J. H. Smith.
Garlock Packing Co., C. D. Allen.
Lead Lined Iron Pipe Co., T. E. Dwyer.
Ludlow Valve Mfg. Co., A. R. Taylor.
MacBee Cement Lined Pipe Co., J. D. MacBride.

H. Mueller Mfg. Co., G. A. Caldwell.
National Meter Co., J. G. Lufkin.
Neptune Meter Co., H. H. Kinsey.
Pittsburgh Meter Co., J. W. Turner.
Rensselaer Valve Co., F. S. Bates, C. L. Brown.
A. P. Smith Mfg. Co., F. L. Northrop.
Standard Cast Iron Pipe & Foundry Co., W. F. Woodburn.
Thomson Meter Co., E. M. Shedd.
Union Water Meter Co., F. E. Hall.
R. D. Wood & Co., H. M. Simons.
Henry R. Worthington, Samuel Harrison, E. P. Howard. — 27.

GUESTS.

A. H. Howard, New York, N. Y.
F. N. Prescott, Boston, Mass.
H. K. Prescott, Waterford, N. Y.
P. E. Gear, Boston, Mass.
Mr. Dennett, Boston, Mass. — 5.

The Secretary presented applications, properly endorsed and recommended by the Executive Committee, from the following named persons:

For Resident Membership.

Alexander Bresth, Boston, Mass., assistant engineer State Department of Health of Massachusetts.

Timothy E. Hopkins, Danielson, Conn., president Crystal Water Co., Danielson, Conn.

W. D. Van Brunt, Southampton, Long Island, N. Y., president of Southampton Water Works.

Hiram Plattner, North Attleboro, Mass., superintendent and engineer North Attleboro Water Department.

Morton B. Wright, North Chelmsford, Mass., superintendent North Chelmsford Fire District.

For Non-Resident Membership.

Charles F. Attersall, Winchester, Ky., superintendent Water Works.

H. F. Dunham, New York City, civil and hydraulic engineer.

H. E. Wolbert, Mt. Vernon, N. Y., superintendent New York Inter-Urban Water Co., Mt. Vernon.

On motion of Mr. Fuller, the Secretary was instructed to cast one ballot in favor of the admission to membership of the gentlemen whose names had been read, and, the Secretary having done so, they were declared elected members of the Association.

MR. W. S. JOHNSON. *Mr. President and Gentlemen,* — Two months ago in the city of Portland the New England Water Works Association held one of the most successful conventions in its history. Towards the success of the convention many things contributed: the beautiful city and its surroundings, the wonderful weather, the splendid work of our members from Portland and

vicinity, and especially the wonderfully attractive and interesting exhibit of water-works appliances which far excelled anything of the kind which has ever been shown in this country. It is upon this last feature of the convention that I wish to say a few words.

The Convention Committee, to whom fell the task of appointing an Exhibit Committee, fully realized that the exhibit of water-works appliances was one of the most important features of our conventions, and it realized, too, that without a great amount of intelligent work on the part of some one man, the exhibit would be a failure. We naturally turned first to the man who had so successfully engineered many previous exhibits, Mr. William F. Woodburn.

Mr. Woodburn felt, and with good reason, that he had done his share, but he was finally prevailed upon to try once more, and with his customary energy he started in to prepare an exhibit which would eclipse all others. I personally know something of the great amount of work he put in during the summer, having repeatedly found him at his office surrounded by diagrams of space, lists of possible exhibitors, and correspondence. Then for a week previous to the convention he was at Portland with his coat off, and his sleeves rolled up, doing three men's work. A paper of tacks is wanted; ask Billy Woodburn. An expressman comes in with a package; see Billy Woodburn. A dispute arises between two exhibitors about some space; Woodburn is the man who settles it all, at the same time putting salve on the wounds so that both men go away feeling that they have been used just about right. And all the time he preserves that good-natured smile on his face, — a smile that is worn, not a mask, but which extends well inside his ample frame.

Mr. Woodburn, I have been asked by the exhibitors at the Portland convention to say a few words to you for them, but I want, first, to take the opportunity to thank you on behalf of the Convention Committee, realizing, as we do, the efficient work which you did, and how much your work contributed to the success of the convention. Now, for the exhibitors at the convention I take great pleasure in presenting you this Masonic charm and chain as a token of their appreciation of your indefatigable energy,

your self-sacrificing helpfulness, your eminent fairness, and your unfailing good nature. And for the rest of the Association, while our expression may not take so substantial a form, I want to assure you that you have the thanks of all members, individually and collectively, and their best wishes for your continued prosperity.

Mr. Woodburn. *Mr. President, Mr. Chairman, and my friends,* — I hardly know what to say. I felt that the many kind words and expressions of appreciation that I heard at Portland on the outcome of our preparation for the exhibitors was more than any man should expect. Every one seemed to be pleased, and that was all I wanted. We did have a little work to do getting ready, but there was always something to it that made it very pleasant. Hearing from a good many old friends in the letters they wrote in reply to my letters and my circulars brought me in contact with them again and naturally rekindled the spark of old friendship. I hardly expected to be rewarded with such a beautiful gift. It is something I have had in mind presenting to myself for some time. I thank you all and regret that I cannot express my thanks in such felicitous language as our chairman has used in presenting this to me.

The President. This is a very pleasing echo of our Portland convention, to the success of which Mr. Woodburn contributed so largely.

Mr. F. A. Barbour, C.E., of Boston, Mass., spoke upon "Leakage from Pipe Joints," which was the subject of a paper presented by him at the Portland convention. The paper was also discussed by Mr. D. A. Heffernan and Mr. Charles W. Sherman.

Mr. Allen Hazen presented the report of the Committee on Meter Rates, Water Loss by Leakage, Non-Registration of Meters or Otherwise.

On motion of Charles W. Sherman, it was voted to accept the report of the Committee on Meter Rates and adopt its recommendations.

Mr. S. A. Agnew, superintendent of the Scituate Water Company, Scituate, Mass., gave an interesting talk on "San Domingo," illustrated by stereopticon views.

Adjourned.

EXECUTIVE COMMITTEE.

Meeting of the Executive Committee of the New England Water Works Association at City Hall, Portland, September 13, 1916.

Present: President William F. Sullivan, and members Caleb M. Saville, Samuel E. Killam, D. A. Heffernan, Robert J. Thomas, Lewis M. Bancroft, George A. King, and Willard Kent.

Forty-one applications for active membership and ten for Associate membership were received and recommended therefor, viz., —

Members.

James P. Allardice, civil engineer, Fall River, Mass.
James Aston, metallurgical engineer, Pittsburgh, Pa.
Charles S. Beaudry, Lexington, Mass.
Clarence A. Bingham, general manager Water Works, Norwood, Mass.
H. W. Bishop, treasurer Boothbay Harbor Water Works, Boothbay Harbor, Me.
Perley J. Blake, superintendent Water Department, Pepperell, Mass.
Theodore L. Bristol, president and manager Water Co., Ansonia, Conn.
A. M. Chaffee, president and general manager Water Co., Oxford, Me.
Jean A. Claman, town engineer, Chicoutimi, Quebec, Canada.
Thurston C. Culyer, engineer in charge Watershed Division, Department Water Supply, Gas and Electricity, City of New York, Purdy's Station (Westchester County), N. Y.
H. L. Elliott, superintendent Rumford & Mexico Water District, Rumford, Me.
Maurice E. Fitzgerald, superintendent South Hadley Falls Water Works, South Hadley, Mass.
Robert Fletcher, president N. H. State Board of Health, Dartmouth College, Hanover, N. H.
Fred C. Gamwell, treasurer Palmer Water Co., Palmer, Mass.
Frederic H. Hapgood, assistant engineer to J. L. Tighe, consulting engineer, Holyoke, Mass.
Herbert L. Hapgood, superintendent Water Works, Athol, Mass.
John W. Hartigan, superintendent Water Works, Longmeadow, Mass.
George A. Hatfield, superintendent Water Works, Sidney, Ohio.
Seba A. Holton, treasurer Board of Water Commissioners, Falmouth, Mass.
Michael H. Harrington, foreman Lowell Water Department, Lowell, Mass.
William F. Hunt, foreman Lowell Water Department, Lowell, Mass.
Howard C. Kinney, superintendent Water Works, Waterloo, N. Y.

Francis D. H. Lawlor, superintendent Citizens Water Co., Burlington, Ia.
William J. Lumbert, superintendent Public Works, Saugus, Mass.
George E. Mann, foreman Woodsville Aqueduct Co., Woodsville, N. H.
William E. Merck, superintendent Water Works, Jackson, Ga.
James Mullins, superintendent Water Works, Springvale, Me.
Patrick T. Mullin, Cambridge Water Works, Cambridge, Mass.
Charles E. McDonald, superintendent Water Works, Waterbury, Conn.
William S. Nolan, civil engineer, East Boston, Mass.
Charles R. Preston, assistant engineer, City Hall, Lowell, Mass.
C. S. Rathbun, assistant secretary Boise Artesian Hot and Cold Water Co., Boise, Ida.
Carl G. Richmond, superintendent Public Works, Revere, Mass.
Adolph D. Theriault, general foreman Pennichuck Water Works, Nashua, N. H.
Earle Talbot, treasurer and assistant superintendent Hackensack Water Co., Weehawken, N. J.
P. Von Weymarn, assistant chief engineer, Reclamation Department, Pishpek, Russia (in Asia).
Ezra B. Whitman, consulting engineer, Baltimore, Md.
Henry F. P. Wilkins, manager Water Department, Marblehead, Mass.
W. H. Williams, superintendent Public Works, Braddock, Pa.
Jesse M. Worthen, M.D., superintendent Charleston Light and Water Co., Charleston, S. C.
John Young, inspector, Sprinklered Risk Department, Western Canada Fire Underwriters Association, Winnipeg, Man.

Associates.

American Manganese Bronze Co., Holmesburg, Pa.
William L. Blake, Portland, Me.
Carbic Mfg. Co., New York City, N. Y.
Chicago Pneumatic Tool Co., Boston, Mass.
Ford Meter Box Co., Wabash, Ind.
C. Godfrey, Atlantic City, N. J.
The Hartford Contractors' Supply Co., Hartford, Conn.
C. M. & H. T. Plummer, Portland, Me.
United Brass Mfg. Co., Cleveland, Ohio.
Winslow & Company, Portland, Me.

One application for reinstatement was received, and it was unanimously voted that the applicant be and hereby is reinstated to membership on his compliance with the requirements of the constitution.

Mr. Charles W. Sherman, for the Committee on Dexter Brackett Memorial, presented the report of that committee with accom-

panying resolution, which is, by unanimous vote, recommended for adoption by the Association.

Mr. Caleb M. Saville, of the Committee on a National Water Law, reports recommending that the said committee be authorized and empowered to confer, participate, and join with committees from other bodies having a like purpose in view, and it was, by unanimous vote, so authorized.

WILLARD KENT, *Secretary.*

Meeting of the Executive Committee of the New England Water Works Association at headquarters, Tremont Temple, Boston, November 8, 1916, at eleven o'clock A.M.

Present: William F. Sullivan, President; Caleb M. Saville, Samuel E. Killam, R. C. P. Coggeshall, F. J. Gifford, Richard K. Hale, Lewis M. Bancroft, George A. King, and Willard Kent.

Eight applications for membership were received, as follows:

Members.

Alexander Bresth, assistant engineer, Massachusetts State Department of Health, Boston, Mass.

William Plattner, superintendent and engineer Water Department, North Attleboro, Mass.

Morton B. Wright, superintendent North Chelmsford Fire District, North Chelmsford, Mass.

Timothy E. Hopkins, president Crystal Water Co., Danielson, Conn.

H. E. Wolbert, superintendent New York Inter-Urban Water Co., Mount Vernon, N. Y.

W. D. Van Brunt, president Southampton Water Works, Southampton, Long Island, N. Y.

H. F. Dunham, civil and hydraulic engineer, New York, N. Y.

Chas. F. Attersall, superintendent Water Works, Winchester, Ky.

And were by unanimous vote recommended therefor.

The proposal of the National Tube Company to exhibit to the Association motion pictures of the manufacture of pipe was, after discussion, laid on the table subject to investigation by the Secretary.

A communication from Mr. F. H. Newell, chairman of Committee on Engineering Coöperation, with reference to the Third Con-

ference of Engineering Societies, was referred to Mr. John W. Alvord, of Chicago, Ill.

The subject of increasing the amount of advertising in the JOURNAL of the Association was discussed, and it was suggested that the members of the Executive Committee make individual effort to accomplish that result.

Mr. S. E. Killam, of the committee on furnishing office at headquarters, reports progress, and it was unanimously voted that the whole question of furnishing be left with the committee, with full power to act.

Voted, that a committee, consisting of the President, the Treasurer, the Advertising Agent, the Editor, and three additional members, to be appointed by the President from the membership residing near Boston, should consider the question of finances and report at the next meeting of the Executive Committee.

Adjourned.

Attest:

WILLARD KENT, *Secretary.*

JOURNAL

OF THE

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INDEX.

Addresses.
President Metcalf. 160 (March).
President Sullivan. 172 (March).
Hon. W. G. Chapman. 486 (Dec.).
W. B. Moore. 488 (Dec.).
Robert E. Peary. 497 (Dec.).
Judge Cleaves. 516 (Dec.).
American Water Works Association. Initiation fee to be remitted. 181 (March).
Automobile in emergency service. 417 (Dec.).

Barbour, Frank A. Leakage from pipe joints. 439 (Dec.).
Barrows, H. K. Improvements to the water supply of the city of Fall River. 46 (March).
Brown, A. W. F. Meter records for small water works. 427 (Dec.).

Chlorine. Water sterilization at Wakefield. (E. C. Sherman.) 135 (March).
Clapp, Sidney K. Detail methods used in the forestation of watersheds. 64 (March).
Clark, Harry W. Double sand filtration of water at South Norwalk, Conn. Removal of organisms, tastes and odors. 86 (March).
Culyer, Thurston C. Costs and results obtained in reforestation of the Croton watershed. 69 (March).

Decolorization of water by storage. (R. H. Stearns.) 20 (March).
Diven, J. M. Reasons for using the double-disk type of valve. 106 (March).
Dredging. Water supply of Salem and Beverly. 42 (March).
Dudley, Arthur W. Experience with wood pipe in New Hampshire. 318 (Sept.).

Fence. Wire fences and concrete posts. New York water supply. (R. N. Wheeler.) 124 (March).
Filtration. Double sand filtration at South Norwalk, Conn. (H. W. Clark.) 86 (March).
Finneran, George H.
An emergency gang in a water service. 413 (Dec.).
Reasons for adopting the solid-wedge type of valve in the Boston Water Department. 101 (March).
Fire protection. Grading water works for fire protection. 513 (Dec.).

Forests.
Detail methods used in the forestation of watersheds. (S. K. Clapp.) 64 (March).
Costs and results obtained in reforestation of the Croton watershed. (T. C. Culyer.) 69 (March).
Hartford, Conn. 74 (March).
New Haven, Conn. 75 (March).
Nashua, N. H. 76 (March).
Wachusett Reservoir, Mass. 81 (March).

Governmental regulation. Control of public utility companies by public-service commissions. (Leonard Metcalf.) 160 (March).

Hall, Harry R. Progress of water disinfection in Maryland. (With R. B. Morse.) 301 (Sept.).
Hydrants. Loss of head in hydrants. 226 (June).

Johnson, William S. Municipal water-works financing in Massachusetts as affected by recent legislation. (With C. W. Sherman and H. A. Symonds.) 279 (June).

Leaks.
Leakage from lead joints in cast-iron water pipe. (A. H. Smith.) 1 (March).
Leakage from pipe joints. (F. A. Barbour.) 439 (Dec.).
Leakage through meters. (Committee.) 453 (Dec.).
Longley, Francis L. Water supply of Salem and Beverly. 35 (March).

Maryland. Progress of water disinfection. (R. B. Morse and H. R. Hall.) 301 (Sept.).
Metcalf, Leonard. Observations upon the control of public utility companies by public-service commissions. 160 (March).
Meters.
Rates. (Report of committee.) 361 (Sept.), 453 (Dec.).
Records. 427, 436 (Dec.).
Suggestion for standard specifications for meters. 430 (Dec.).
Morse, Robert B. Progress of water disinfection in Maryland. (With H. R. Hall.) 301 (Sept.).

New England Water Works Association.
Address by President Metcalf. 160 (March).
Address by President Sullivan. 172 (March).
Committee on arrangements for convention. 299 (June).
Committees appointed:
Grading water-works for fire protection. 177 (March).
On quarters. 412 (June).

Specifications for water meters. 438 (Dec.).
On nominations. 495 (Dec.).
Uniform statistics. 497 (Dec.).
Committee reports:
Dexter Brackett memorial. 492 (Dec.).
Final report on meter rates. 361 (Sept.), 453 (Dec.); report accepted. 534 (Dec.).
Grading water-works for fire protection. 513 (Dec.).
Exhibits. 528 (Dec.).
Election of officers. 170 (March).
Principal statistics. 153 (March).
Proceedings:
Annual meeting. 143 (March).
Feb. 9, 1916. 173 (March).
March 8, 1916. 289 (June).
June 21, 1916. 291 (June).
Sept. 13, 14, 15, 1916. 479 (Dec.).
Nov. 8, 1916. 531 (Dec.).
Executive Committee:
Jan. 12. 180 (March).
Feb. 9. 181 (March).
March 8. 295 (June).
March 29. 295 (June).
June 21. 296 (June).
Aug. 8. 412 (Sept.).
Sept. 13. 535 (Dec.).
Nov. 8. 537 (Dec.).
Reports of officers:
Auditing Committee. 159 (March).
Editor. 156 (March).
Executive Committee. 145 (March).
Secretary. 150 (March).
Treasurer. 152 (March).
New Hampshire. Experience with wood pipe. (A. W. Dudley.) 318 (Sept.).

Peary, Robert E., U.S.N. Address. 497 (Dec.).
Pipe.
Leakage from pipe joints. (F. A. Barbour.) 439 (Dec.).
Loss of head in cast-iron pipe. 214 (June).
Testing distribution mains. 218 (June).
Pipe inspection. 221 (June).
Wood pipe experiences. 318 (Sept.).
Portrait. Sullivan, William F. Frontispiece.

Posts. Concrete posts and wire fences, New York water supply. (R. N. Wheeler.) 124 (March).
Pumps. Tests of centrifugal pumps. 205 (June).

Sampson, George A. The Middleboro, Mass., reinforced concrete standpipe. 251 (June).
Saville, Caleb Mills. Some water-works experiences in Hartford, Conn. 195 (June).
Sedgwick, William T. Water supply sanitation in the nineteenth century and in the twentieth. 183 (June).
Sherman, Charles W.
Grouting or cushioning standpipe bases. 131 (March).
Revenue and operating expenses of municipally owned water-works in Massachusetts in 1913. 260 (June).
Municipal water-works financing in Massachusetts as affected by recent legislation. (With W. S. Johnson and H. A. Symonds.) 279 (June).
Sherman, Edward C. The Wakefield water sterilization plant. 135 (March).
Smith, Arthur H. Leakage from lead joints in cast-iron water pipe. 1 (March).
Standpipes.
Grouting or cushioning standpipe bases. (C. W. Sherman.) 131 (March).
Reinforced concrete standpipe at Middleboro, Mass. (G. A. Sampson.) 251 (June).
Stearns, Ralph H. Decolorization of water by storage. 20 (March).
Sullivan, W. F., President N. E. W. W. Association. Portrait. Frontispiece.
Symonds, Henry A. Municipal water-works financing in Massachusetts as affected by recent legislation. (With C. W. Sherman and W. S. Johnson.) 279 (June).

Thomas, Robert J. Suggestion that the Association appoint a committee to prepare standard specifications for water meters. 430 (Dec.).

Valves.
The solid-wedge type of valve in Boston, Mass. (G. H. Finneran.) 101 (March).
The double-disk valve. (J. M. Diven.) 106 (March).
Double check valves. 239 (June).
Operation by automobile. 426 (Dec.).

Water purification.
Decolorization of water by storage. (Ralph H. Stearns.) 20 (March).
Double sand filtration at South Norwalk. (H. W. Clark.) 86 (March).
Water sterilization plant at Wakefield, Mass. (E. C. Sherman.) 135 (March).
Water supply sanitation. (W. T. Sedgwick.) 183 (June).
Water disinfection in Maryland. (R. B. Morse and H. R. Hall.) 301 (Sept.).

Water rates. Report of committee on meter rates. 361 (Sept.), 453 (Dec.).
Water supplies.
Salem and Beverly. (F. L. Longley.) 35 (March).
Fall River improvements. (H. K. Barrows.) 46 (March).
South Norwalk, Conn., filtration. (H. W. Clark.) 86 (March).
Wakefield, Mass., sterilization. (E. C. Sherman.) 135 (March).
Hartford, Conn., experiences. (C. M. Saville.) 195 (June).
Middleboro, Mass., standpipe. (G. A. Sampson.) 251 (June).
Brockton, Mass., auxiliary supply. (R. S. Weston.) 324 (Sept.).
Water-works management.
Revenue and operating expense of municipally owned water-works in Massachusetts in 1913. (C. W. Sherman.) 260 (June).
Municipal water-works financing in Massachusetts as affected by recent legislation. (C. W. Sherman, W. S. Johnson, and H. A. Symonds.) 279 (June).
Emergency gangs. (G. H. Finneran.) 413 (Dec.).
Meter records. 427, 436 (Dec.).
Weston, Robert Spurr. Proposed auxiliary water supply of Brockton, Mass. 324 (Sept.).
Wheeler, Ralph N. Wire fences and concrete posts. 124 (March).

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INDEX OF ADVERTISERS.

	PAGE.
Ashton Valve Co.	xv
Buffalo Meter Co.	ix
Builders Iron Foundry	xi
Chadwick-Boston Lead Co.	xxiv
Chapman Valve M'f'g Co.	xviii
Clark, H. W. Co.	xii
Coffin Valve Co.	xxv
Conard, Wm. R.	i
Dixon, Jos. Crucible Co.	xii
Donaldson Iron Co.	xxi
Eddy Valve Co.	xx
Engineering Record, The	xxviii
Fox, John & Co.	xxiii
Hayden, James F.	i
Hays M'f'g Co.	xiii
Hersey M'f'g Co.	iv
Hill, Nicholas S., Jr., & S. F. Ferguson	i
Houdlette, Fred A., & Son	xii
Lead Lined Iron Pipe Co.	xxiii
Leadite Co.	xxvi
Lock Joint Pipe Co.	xxvii
Ludlow Valve M'f'g Co.	xvii
MacBee Cement-Lined Pipe Co.	xii
Metcalf & Eddy	i
Mueller, H. M'f'g Co.	xiv
National Meter Co.	ii, iii
National Water Main Cleaning Co.	xii
Neptune Meter Co.	vi
New York Continental Jewell Filtration Co.	xxi
Norwood Engineering Co.	xv
Pitometer Company	x
Pittsburg Meter Co.	vii
Rensselaer Valve Co.	xix
Ross Valve M'f'g Co.	xv
Smith, The A. P. M'f'g Co.	xxiii
Smith, B. F. & Co.	xi

(Index continued on page xvii.)

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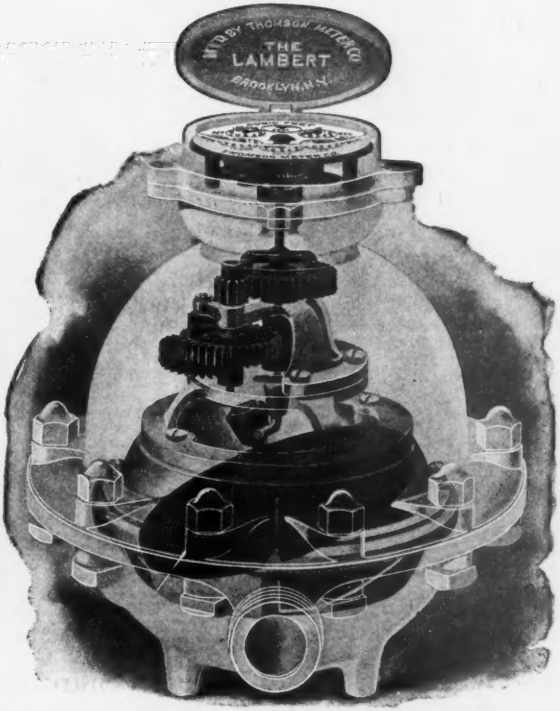

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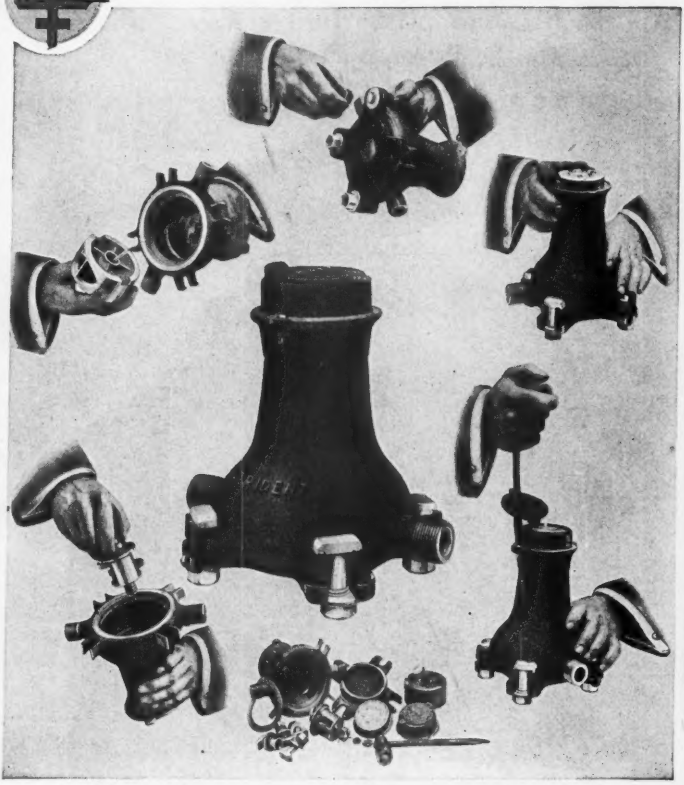

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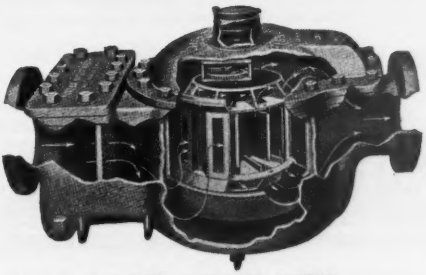

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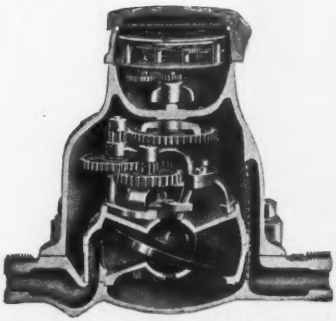

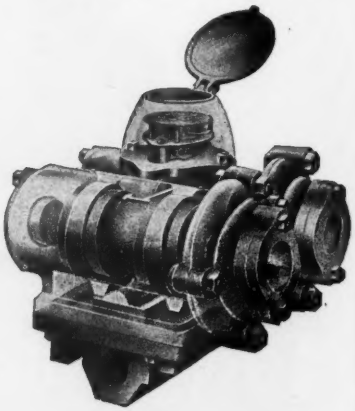

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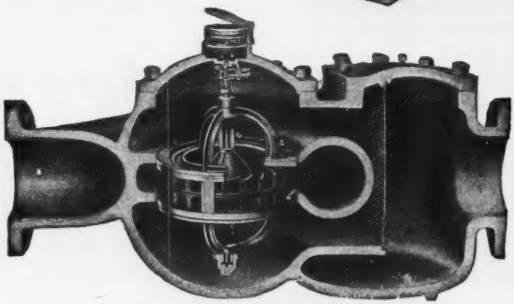

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W159.8

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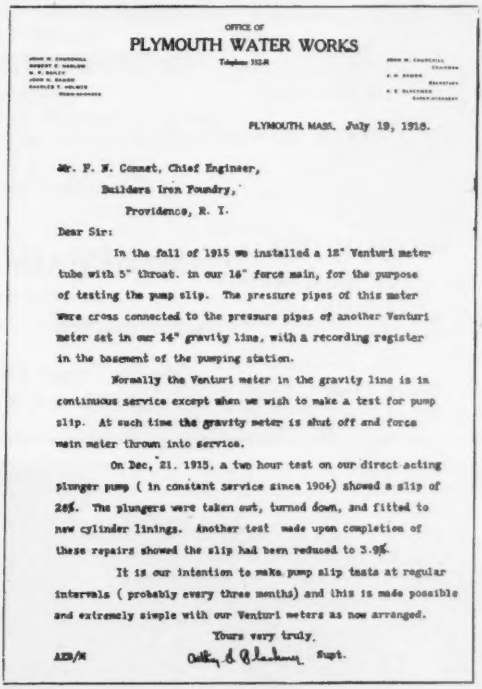

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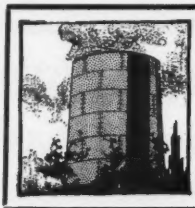

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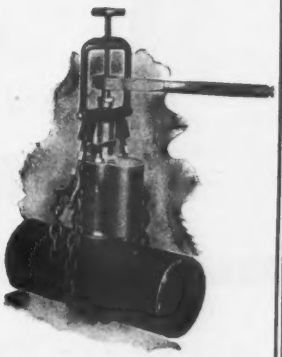

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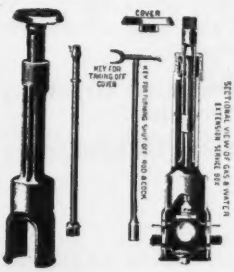

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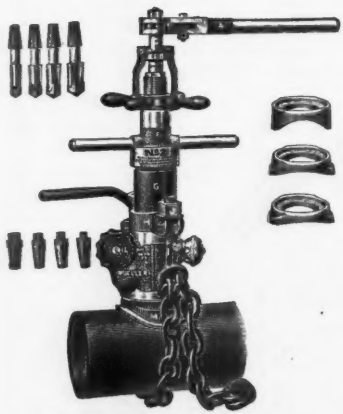

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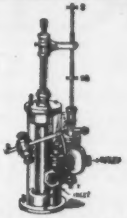
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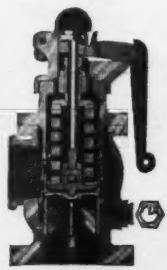
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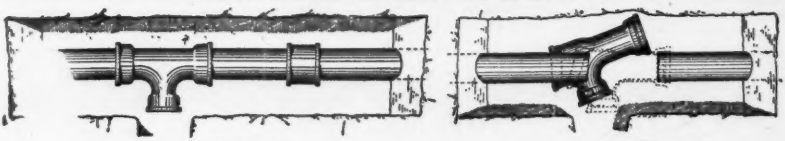

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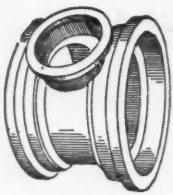

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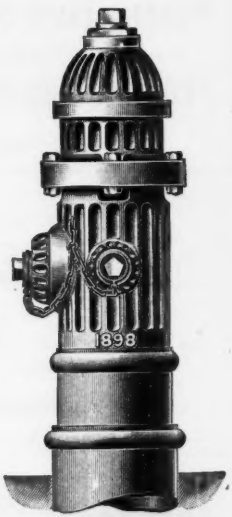

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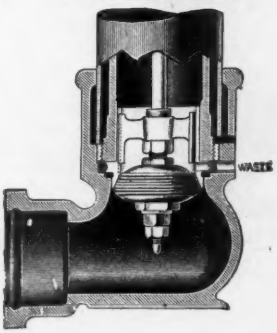

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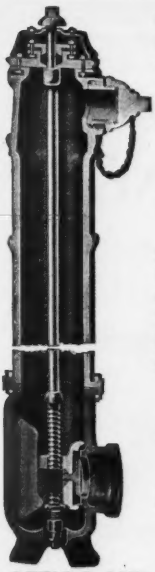

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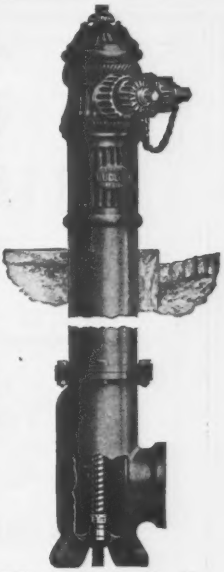

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INDEX OF ADVERTISERS. (*Continued*).

	PAGE.
Thomson Meter Co.	v
Union Water Meter Co.	x
U. S. Cast Iron Pipe and Foundry Co	xxii
Warren Foundry and Machine Co.	xix
Wood, R. D. & Co.	xvi
Woodburn, Wm. F.	xii
Worthington, Henry R.	viii

CLASSIFIED DIRECTORY OF ADVERTISEMENTS.

ARTESIAN AND DRIVEN WELLS.

B. F. Smith & Co. . . . xii

BRASS GOODS.

Hays M'f'g Co. . . . xiii
H. Mueller Mfg. Co. . . . xiv
The A. P. Smith M'f'g Co. . . . xxiii
Union Water Meter Co. . . . x

CAST IRON PIPE AND SPECIALS.

Builders Iron Foundry . . . xi
Donaldson Iron Co. . . . xxi
John Fox & Co. . . . xxiii
Houdelette, Fred A., & Son . . . xii
U. S. Cast Iron Pipe and Foundry Co. . . . xxii
Warren Foundry and Machine Co. . . . xix
R. D. Wood & Co. . . . xvi
Woodburn, Wm. F. . . . xii

CEMENT-LINED PIPE.

MacBee Cement-Lined Pipe Co. . . . xii

(*Index continued on page xxv.*)

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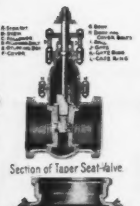
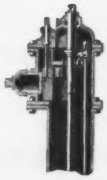
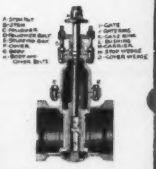
FIRE HYDRANT



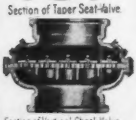
Section of Taper Seat-Valve.



Hydrant with independent Nozzle Cut-off.



Section of Parallel Seat-Valve.



Section of Vertical Check-Valve.

Section of Vertical Foot-Valve.

Horizontal Check-Valve.

Vertical Foot-Valve.

Hydrant with Water Crane Attachment.

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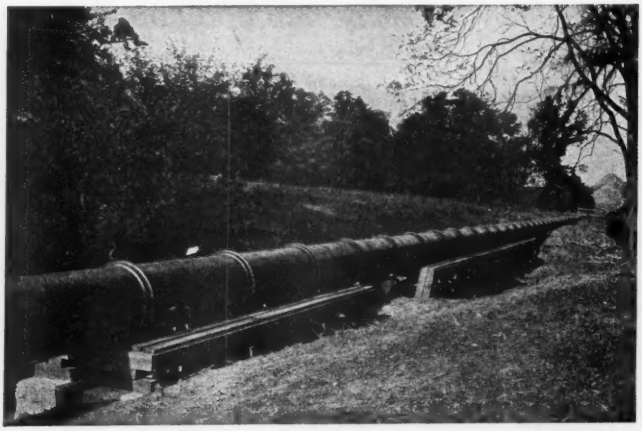

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CLASSIFIED DIRECTORY OF ADVERTISEMENTS (*Continued*).

	PAGE.
CLEANING WATER MAINS.	
National Water Main Cleaning Co.	xii
FILTERS AND WATER SOFTENING PLANTS.	
New York Continental Jewell Filtration Co.	xxi
Norwood Engineering Co.	xv
Ross Valve M'f'g Co.	xv
FURNACES, ETC.	
H. Mueller Mfg. Co.	xiv
The A. P. Smith M'f'g Co.	xxiii
The Leadite Co.	xxvi
GAS ENGINES.	
National Meter Co.	iii
GATES, VALVES, AND HYDRANTS.	
Ashton Valve Co.	xv
Chapman Valve M'f'g Co.	xviii
Coffin Valve Co.	xxv
Eddy Valve Co.	xx
John Fox & Co.	xxiii
Ludlow Valve M'f'g Co.	xvii
Norwood Engineering Co.	xv
Rensselaer Valve Co.	xix
Ross Valve M'f'g Co.	xv
The A. P. Smith M'f'g Co.	xxiii
R. D. Wood & Co.	xvi
INSPECTION OF MATERIALS.	
Wm. R. Conard	i
J. F. Hayden	i
LEAD AND PIPE.	
Chadwick-Boston Lead Co.	xxiv
Lead Lined Iron Pipe Co.	xxiii

Index continued on page xxix.)

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CLASSIFIED DIRECTORY OF ADVERTISEMENTS (*Concluded*).

PAGE.

LEADITE.
The Leadite Co. . . . xxvi

METERS.
Buffalo Meter Co. . . . ix
Builders Iron Foundry . . . xi
Hersey M'f'g Co. . . . iv
National Meter Co. . . . ii
Neptune Meter Co. . . . vi
Pitometer Co. . . . x
Pittsburg Meter Co. . . . vii
Thomson Meter Co. . . . v
Union Water Meter Co. . . . x
Henry R. Worthington . . . viii

METER BOXES.
Clark, H. W. Co. . . . xii
Hersey M'f'g Co. . . . iv

OIL, GREASE, ETC.
Jos. Dixon Crucible Co. . . . xii

PIPE JOINTS.
The Leadite Co. . . . xxvi

PRESSURE REGULATORS.
H. Mueller Mfg. Co. . . . xiv
Ross Valve M'f'g Co. . . . xv
Union Water Meter Co. . . . x

PUMPS AND PUMPING ENGINES.
Builders Iron Foundry . . . xi
National Meter Co. . . . ii
R. D. Wood & Co. . . . xvi

REINFORCED CONCRETE PIPE.
Lock Joint Pipe Co. . . . xxvii

TAPPING MACHINES.
Hays Mfg. Co. . . . xiii
H. Mueller Mfg. Co. . . . xiv
The A. P. Smith M'f'g Co. . . . xxiii

TOOLS AND SUPPLIES.
H. Mueller Mfg. Co. . . . xiv
The A. P. Smith M'f'g Co. . . . xxiii
Hays M'f'g Co . . . xiii
The Leadite Co. . . . xxvi

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